THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXVIII. No. 21. Whole No. 1,459. | NEW YORK, MONDAY, MAY 25, 1903. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 42 Pine Street, New York.

Telephone.—2996 John.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs). All payments to be made in advance. Single copies, 10 cents.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Special Editorial Correspondence by Telegraph—Twenty sixth Annual Meeting of the Western Gas Association..... 801
Some Uses of the "Cox Computer," by Mr. Walton Forstall..... 802
Experiences with Cement Joints for Street Mains, by Mr. B. F. Bullock 803
*Bavarian Government Reports on Lighting in Schools, Etc..... 803
Determining the Density of Smoke..... 805
Chicago Discussion of Central Station Tendencies..... 805
*The Manufacture of Incandescent Electric Lamps in England..... 806
The Comparative Duration of Horizontal and Inclined Retorts..... 809
Transmission of Power by Gas..... 810
A Statement from the Trustees of the Gas Educational Fund 811
ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 812

Expanding Business, the Cabot Specialties—A Wail from San Francisco—Annual Meeting, Sandy Hill, N. Y.—The Readjustment of the Finances of the Washington (D. C.) Company—Supt. G. H. Brown makes a Suggestion—Mr. M. E. Malone Goes to Denver, Col.—Gas Plant for Hancock, Mich.—The Hammonton (N. J.) Company—Dividend on the Preferred, Massachusetts Gas Companies—Gas Works for Carterville, Md.—Annual Meeting, Bristol, Pa.—Gas Works for Cleburne, Tex.—Death of Capt. David Boynton—Cheaper Gas for Merced Falls, Cal.—Electric Light Work Construction, Paris, France—And Other Items.

The Market for Gas Securities..... 814

[Special Editorial Correspondence by Telegraph.]

TWENTY-SIXTH ANNUAL MEETING OF THE WESTERN GAS ASSOCIATION.

INDIANAPOLIS, IND, May 20, 1903.

Dear JOURNAL: More history has been made in connection with the Western Gas Association, and while it is history in common with the general run of all such recording, in that repetition is the basis of it all, and that all of the Western's gatherings have been successful ones, nevertheless it is so that this session was at once successful and original. It might be that the weather was warm enough to make one sizzle, and that the meeting room in the Claypool was rather small, hence a bit stuffy, but such inconveniences were altogether too unimportant to prevent a large, representative attendance from paying close heed to the business in hand. Outside of the meeting room, this handsome, well-appointed hotel was up to responding freely to the demands made upon it by its guests, and the house would be a credit even to your own hotel-strewn city. An excellent attendance greeted the call to order of the Association's President, Mr. A. H. Barret, of Louisville, Ky., when shortly after 10 this morning the gavel fell. Alongside of him was Secretary Dunbar, whom we were all glad to hear had been persuaded not to relinquish the position the duties of which he had so admirably performed for virtually a decade. President Barret lost no time in introducing the Mayor of Indianapolis, Mr. Chas. A. Bookwalter who welcomed the Association in neat speech, the response to which was softly and cleverly made by Mr. Paul Doty. President Barret, who is nothing if not original, then thanked the Association for the honors it had conferred upon him in naming him to preside over the deliberations, and remarking that the members would undoubtedly be better entertained in the regular order of business than in listening to an address from him, calmly called for routine matters. Then followed in quick succession the report of tbe Board of Directors and a statement from Mr. Somerville respecting the entertainment prepared for the gentler delegates by the Arrangement Committee. The scheme was not very different from that reported in the JOURNAL for last week, save that an additional most acceptable number was an invitation to attend the concert in Assembly Hall, Claypool Hotel, the main attraction being the incomparable Mme. Schumann-Heinck. Next followed the adoption of an invitation from the Commercial Club, extending to the members the privileges of its house during their stay; an invitation from Mr. H. J. McGowan, President of the Indianapolis Street Railway, to use its rolling stock, including his private car, and an invitation from the Indianapolis *News* to have the members gather at the Soldiers' Monument to be photographed *en masse*. The technical proceedings proper were then brought on in the reading, by Mr. Thos. D. Miller, of New Orleans, La., of his paper descriptive of the "High Pressure Gas Main under the Mississippi River at New Orleans." It is needless to say that Mr. Miller's presentation of his subject was concise and clear and interesting. The discussion on the paper, which was not of the type that its subject matter deserved, having been closed, the President called for the promised paper on "Low Candle Power," by Capt. W. H. White, of your city. The "Cap." explained that, owing to the trip abroad indulged by him early this year, he had been unable to put the necessary facts together, but reserved the subject for next year's meeting, when his promise to Mr. Barret would be redeemed during the reign of Mr. Shelton. The Association then listened to the paper by Mr. James Somerville on "The Most Economical Yield per Pound of Coal." It is not necessary for me to say that this Dean of the gas profession is fitted to speak on such a subject, but I may and do say that his remarks thereon were up to his knowledge, gained in many a hand-to-hand encounter with the material and practice of which he spoke and wrote. This brought the proceedings of the first morning to a close.

The afternoon session was opened by the reading of a telegram from Mr. John Dell, of St. Louis, who said that illness alone could keep him away from the Western's sessions. It was the first of the meetings that he had missed. Then came the paper by that one whom every gas man respects and loves—Mr. John McIlhenny, of Philadelphia. His appearance was the signal for prolonged applause, and I am not outside the truth when I deliberately say that the grizzled, glorious old gas man actually blushed at his reception. Could the subject of "Gas and Meters" been more ably handled by another man; not at all. The cheering at the close of his reading was about as voluminous and continued as that which greeted his appearance on the platform, and the cheering broke out anew during and after the speech by Captain White, awarding the veteran a vote of thanks. The Association sensibly determined not to hold an evening session and the election for officers was held with the following result:

LIBRARY OF CONGRESS
MAY 25 1903
SMITHSONIAN DEPOSIT

President—Mr. F. H. Shelton, Philadelphia, Pa.
First Vice-President—Mr. O. O. Thwing, St. Louis, Mo.
Second Vice-President—Mr. Paul Doty, Detroit, Mich.
Secretary and Treasurer—Mr. James W. Dunbar, New Albany, Ind.
Editor Wrinkle Department—Mr. Wm. E. Steinwedell, Cleveland, O.
Directors.—Messrs. K. M. Mitchell, Wm. McDonald, T. G. Miller and J. D. McIlhenny—to serve 2 years; and Mr. D. R. Warmington—to serve 1 year.

Messrs. Shelton, Thwing, Doty and Dunbar made felicitous speeches in acknowledgment of their promotion and continuance, and a rousing cheer greeted "Jim's" acknowledgment that he would remain in harness. After the adjournment, which was reached at 3 P.M., a goodly party journeyed to the Soldiers' Monument, where they "were done" in photographic style. When the "posing" was over many remarked that the next number of the Indianapolis *News* would indeed look like "a gallery." The plan to give a smoker for the boys, the evening of Thursday, at the Claypool, has been abandoned, chiefly owing to the heat and the fear that under such atmospheric conditions the hall would be uncomfortable. Instead the members will, at 6 P.M., take conveyances to "Fairbanks," at which popular resort a dinner will be served. The attendance, which was excellent, increases all the time, and everyone has good reports to make respecting the state of trade, prospects for its growth and the like.—S.

INDIANAPOLIS, Thursday, May 21.

Dear JOURNAL: The second day's sessions were commenced by the election of new members, of whom 37 were admitted—26 active and 11 associate. St. Louis having been named as the next meeting place, the Association listened to the report of the committee on publishing the proceeding, which was presented by Mr. O. O. Thwing. A hearty vote of thanks was awarded the committee and its continuance was ordered. Similar action was taken in respect of the report of the committee on library, which was made by Mr. F. H. Shelton. The paper by Mr. B. W. Perkins, of South Bend, Ind., on "Increasing Sales of Gas to Existing Consumers," was then read and discussed, after which came the paper (it really was a lecture) by Dr. W. H. Birchmore, of Brooklyn, N. Y., on the topic of "Naphthaline." The Doctor illustrated his lecture by a profuse series of experiments, and the care with which his text and experiments were listened to and inspected is the best proof that the hour so taken up was well worth while. This brought the morning session to a close. The afternoon's proceedings were opened by the reading of a short discussion on Dr. Birchmore's lecture, which discussion was handed in by Mr. W. E. Steinwedell. The Association then listened to the report of the committee on gasholder specifications, which very sensible document was arranged by Mr. H. A. C. Carpenter, of Pittsburg, Pa. Next followed the report of the committee on memorials, read by Mr. T. G. Miller, which fraternal testimonial to the memories of the Association's deceased was adopted by rising vote. On motion of President Barret, seconded by Captain White, your Mr. T. J. Cunningham was unanimously elected to Honorary Membership by rising vote. The collection of "Wrinkles," edited by Mr. W. E. Steinwedell, was then put forward by him, and the rousing discussion which ensued should be proof to the clever son of his honored father that his work had not been in vain. The paper, by Mr. H. A. Wheeler, of St. Louis, Mo., in the absence of the author was read by Secretary Dunbar, and then the paper, by Mr. Arthur E. Boardman, of New York, was read by Mr. T. G. Miller, Mr. Boardman being in Europe. In fact, his paper was completed while he was aboard ship en route to Plymouth. The paper, which was on the subject of "Municipal Ownership," was an exceptionally able one, and its thoughts evoked a good, useful discussion. There was no set report from the Committee on World's Fair, but the matter was well threshed out in a debate, that terminated in the decision to leave the whole affair in the hands of President-elect Shelton and his aides. The Question Box was next disposed of, and a short paper, by Mr. F. H. Shelton, was taken as read, on account of the lack of time to discuss it properly. The usual vote of thanks brought the regular business to a close. This afternoon a thundershower was gratefully welcomed, in that it cooled off the atmosphere and made things all right for the trolley ride, which was shared in by 100 or more. The visit was made to the Dutch House instead of to "Fairbanks," and the informality of the gathering was delightful. Mr. Pearson made an excellent host. The meeting was a good one in every sense. President Barret knew his business and lived up to it, as did the other officers and members as well. Our local hosts left nothing undone for our comfort. To sum it up, the record of the 26th meeting of the Western was and is all that could be desired.—S.

[Prepared for the JOURNAL.]

Some Uses of the "Cox Computer."

[By Mr. WALTON FORSTALL.]

Some years ago I was looking over pressure charts, taken on evenings of greatest output on trunk mains leading from works and holder stations, and in noting the lowest pressure shown it occurred to me to ascertain the amount of gas per hour passing out through these trunk mains. The pressure at all governor outlets was known, of course, and pressures had been taken on the trunk mains, either at the points where the first large mains went from these trunks mains or between such points and the holder stations. The drop in pressure between the governor outlets and the various points on the trunk mains would indicate with very little error the rate of gas flow in these mains. A proof of this was the agreement I found between the sum of the amounts, indicated as flowing at the time of maximum output through the various mains leading from any one station and the amount of gas being delivered from that station at that time, as measured by the fall of the holders. For instance: If station "X" showed that, for a 5-minute period at 5.45 P.M., the holders were falling at a rate of 300,000 cubic feet per hour, pressure taken in the two mains leading from the station accounted for this rate of flow and showed how much gas each main was taking.

This agreement between station outputs, as shown by holder measurements and as deduced from drop in pressures on trunk mains, was so satisfactory, that I decided to trace the maximum delivery of the various trunk mains to their end, by means of pressures taken along these mains at every point of junction with a main 12 inches or over in size, ignoring any smaller mains. The results were very interesting, and I got a much better idea of the varying rates of consumption along the lengths of the different trunk mains than would ever have been given me by a comparison of pressures solely. I was perfectly well aware that my method of considering each section of the trunk main, as having no outlets between the two pressure points, made the deliveries shown between any two such points in error; but I was not after absolute figures, so much as for comparative ones, and in any case, on some 30-inch mains large for their output, the chance for error in the Bristol gauge as used in the street, say $\frac{1}{10}$ of an inch, was large enough in itself to have made it unwise to consider the effect of 6-inch outlets from such 30-inch mains.

The reason for my title is plain enough by this time, and if I had not had on my desk a "Cox Computer" when the idea of getting volumes occurred to me, it is very probable I would not have followed up the thought by the laborious working out of Pole's formula; and certainly the delivery of gas would never have been traced to the extent I now do.

The following table shows the shape in which the computer results are put down. It is part only of a more complete table treating of the total output from a holder station. The part shown traces the delivery of gas out A street, from point 1 to point 13, there being a 30-inch main and a 20-inch main to point 2, and a 20-inch only beyond that point; and, also, the delivery north from A street, through 16-inch and 12-inch mains at various points. Column "B" shows that the distribution is for the most part uphill, naturally to our great advantage. For instance, between points 1 and 2 there is an actual loss of only $\frac{3}{10}$-inch as shown by the gauge, but as point 2 is 49 feet higher in elevation, and with gas at our gravity every 18 feet is equivalent to $\frac{1}{10}$-inch increase in pressure, there is really between points 1 and 2 a friction loss of $\frac{6}{10}$-inch, and the computer shows that, with this loss for the distance of 4,150 feet, the 20-inch will deliver 63,000 cubic feet per hour and the 30-inch, 173,000. The figures in column "H" show the delivery between these same points in 1901, the 20-inch being the only main in existence at that time. At point 2, a 16-inch main runs north from A street to point 3 before being tapped by any large main, and (2-3) shows that 7,000 cubic feet of gas go out through it. From point 3, a 16-inch continues to 4, and (3–4) shows 28,000 cubic feet going beyond 3, the amount of this decrease being fully explained by the mains tapping the 16 inch at point 3. Following down, the table (10–13) shows only 27,000 cubic feet reaching point 13, or about one-ninth of the amount leaving point 1.

It is the comparison between "G" and "H," the figures for 1902 and 1901, that forms the meat of this cocoanut, and it is for the sake of such a comparison of *deliveries*, rather than of *pressures*, that as said before the table is made. With a knowledge of the probable growth in each region of a city it becomes fairly easy to predict the maximum delivery each section of main will be called for during the year to come, and knowing this, the drop in pressure is given by the computer, and the

extent of such drop determines the necessity for new trunk mains. In this way the end for which the pressures were taken is attained, and with very small expenditure of time, thanks to the computer.

"A."	"B." Elevation. Feet.	"C." Pressure in 10ths of Ins.	"D." Friction Loss in 10ths.	"E." Distance in Feet.	"F." Size of Main. Inches.	"G." Delivery in —Cubic feet per Hour.— 1902.	"H." 1901.
1	44	36	....	....	....	....	....
	....	(1–2)	6.0	4,150	30	173,000	....
					20	63,000	92,000
2	93	33	....	....	....	....	....
	....	(2–3)	15.0	2,600	16	70,000	41,000
3	102	18	....	....	....	....	....
	....	(3–4)	2.5	2,700	16	28,000	26,000
4	112	16	....	....	....	....	....
	....	(2–5)	9.0	3,400	20	84,000	*33,000
5	68	23	....	....	....	....	....
	....	(5–6)	2.0	1,400	16	35,000	....
6	71	21	....	....	....	....	....
	....	(5–7)	2.5	1,500	20	66,000	*33,000
7	88	21.5	....	....	....	....	....
	....	(7–8)	2.5	1,700	20	62,000	†13,000
8	105	20	....	....	....	....	....
	....	(8–9)	3.0	1,900	12	18,000	....
9	102	17	....	....	....	....	....
	....	(8–10)	2.5	4,500	20	38,000	†13,000
10	104	17.5	....	....	....	....	....
	....	(10–11)	1.0	1,700	12	11,000	....
11	108	16.5	....	....	....	....	....
	....	(10–12)	.5	3,600	12	5,200	....
12	102	17	....	....	....	....	....
	....	(10–13)	.5	1,800	20	27,000	†13,000
13	82	16	....	....	....	....	....

* This was the delivery between points 2 and 7 in 1901, no pressure being taken that year at point 5, as the 16-inch line from point 5 to point 6 was not then in existence.

† This was the delivery between points 7 and 13 in 1901.

[Prepared for the JOURNAL.]

Experiences with Cement Joints for Street Mains.

By MR. B. F. BULLOCK.

The attention of gas engineers has been from time to time called to cement to be used as a substitute for lead in making joints in cast iron street mains. The writer was a few years ago connected with a company that used cement joints exclusively, except at street crossings, where lead was used, and one very wet place where the water could not be kept below the pipe long enough to give the cement time to set. We used the "Globe Brand" Portland cement. We had no machine for testing the tensile strength, but all other tests tended to show it to be of very good quality.

About two months after gas had been turned on the manager had some of the joints examined, and was so favorably impressed that an extension put in shortly afterwards was made entirely of cement, even at street crossings.

The sizes of pipe were 4-inch, 6-inch, 8-inch and 10-inch. No trouble was experienced for about a year, but then we began to get "Smell of Gas" reported from different parts of the town, and as the writer was foreman at the time the work of repairing the leaks then fell upon him.

When the joints were uncovered it was always found that the heading left on the outside of the pipe had broken off, and the cement in the joints showed cracks parallel with the pipe, sometimes as many as six or seven in one joint.

The joints were made according to the instructions sent out to the "Practical Class" of the American Gas Light Association, and the repairs made from the same directions. The repairs were quite difficult to make, as sometimes all of the cement had to be cut out of the joint, the cracks being so numerous, and this was always accompanied with an escape of gas, which on several occasions came near asphyxiating the men engaged.

Even when there is only one crack in the joint, and all the cement did not have to be cut out, it was necessary to cut around at least one-third of the circumference and entirely down to the yarn. Tarred hemp is best to use in recalking, but even with this it is difficult to stop all leaking. If the least gas is allowed to escape it will blow holes in the joint.

We found the best way to repair them was to wet the joint well, then put in some dry cement. The small quantity that gets wet will set very quickly and then the joint can be filled with cement, mixed with water just so it will stick together when squeezed in the hand.

Finding the joints leaking caused some uneasiness among the citizens who opposed the cement in the first place, and as an asphalt pavement was to be laid on the main street it was thought best to examine all of the joints. The writer was appointed to do this work also, and for the benefit of those who might be contemplating the use of cement, will state what was found.

The ground in which the mains were laid was sandy by nature and light in color, and around 9 out of every 10 joints this had turned black, indicating a leakage.

Some of the joints would not flash when a light was applied, still the odor of gas was noticeable. Three out of every five leaked so much that the gas flashed, and some of them leaked badly. Our method of making the joints was as follows:

Three strands of untarred hemp (the same as is ordinarily used when joints are made with lead) were twisted together, and put around the spigot end, and shoved in the bell when the pipes were put together. This rolls it well back on the bottom. After setting the pipe at grade, the roping was calked backed hard and the length cross-filled. It was then ready for the cement. Enough for one joint of the larger sizes, or two of the smaller was mixed, and while this was being put in, a man was preparing another batch so that it was always freshly mixed.

As much cement as could be was forced in with a small pointing trowel; then, one-half strand of roping was put in and firmly driven back with a roping tool. This forces the cement well back in the joint. It was again filled with cement and a bead left on the outside. It was then dusted over with dry cement and covered with boards, if the sun shone directly on it, to prevent uneven setting, and wherever we could the holes remained open all night to give sufficient time for setting.

The joint-maker was never nearer than seven lengths to where the pipe was being laid, so the joints were never affected by being jarred when the pipe was rammed home, or settled to get a good foundation.

Joints were never made in rainy weather, or weather so cold that the cement would freeze.

I have since tried joints made with cement just stiff enough not to run out all the way—so stiff that I could hardly get it in the joint—with no better result. Then I tried mixing sand with the cement—clean, fine, sharp river sand—and in my estimation, mixing two parts of cement to one part of sand made the best joint. They did not seem to be any more porous, and certainly did not crack as badly as neat cement did. It undoubtedly takes more time to make a cement than a lead joint, therefore costing more for labor, making the difference in cost between cement and lead only a few cents in favor of the cement; but in consideration of the constant leakage of gas, amounting doubtless to many dollars in the lifetime of such a joint, the few cents difference of first cost cuts no figure at all, consequently if left to my discretion which to use, taking my past experience into consideration, I would use the good, old-fashioned lead.

Bavarian Government Reports on Lighting in Schools, Etc.[1]

The Bavarian Government have for years been taking a keen interest in the question of the best lighting for schools and similar institutions, and some of the official returns recently made to it have been summarized in two numbers of the *Journal für Gasbeleuchtung*. We give the leading results in a still further abbreviated form.

I.—SURGEON-GENERAL K. SEGGEL, M.D.; report revised by the Medical Faculty of the University of Munich: Hygienically, petroleum lamps and flat flame and Argand gas burners are excluded; the choice really is between Welsbachs and electric lamps. Welsbachs may be used for direct or indirect lighting, arc lamps for indierct, electric incandescents for direct lighting.

Direct Lighting.—Welsbachs or electric incandescents. Advantages of Welsbachs, more uniform distribution of an illumination sufficient for work, better illumination at some distance to one side, greater illuminating power with less radiation of heat (about 55 per cent.); disadvantage, more heat liberated in hot gases and steam, though less heat directly radiated. Products of imperfect combustion are practically *nil* in Welsbachs, and the total heat liberated is not considerable in any case; and the results are easily within control by ventilation. Further, the Welsbachs give more trouble, but cost less.

Direct v. Indirect Lighting.—Direct gives more powerful illumination; but more radiation of heat and blinding of the eyes. The radiation of heat causes dryness in the eyes, a feeling of tension in the forehead,

1. The *Gas World*.

heat in the head, headache. The irritation by the direct light causes congestion of the retina, and a demand for better and better light. Both Welsbachs and electric incandescents can be shaded off by conical lamp shades if the lights are placed low; but the contrast between the bright desk and paper and the dark room is bad for the eyes, and the arrangement is only in some cases possible. If the lamp shades are of milk glass and the lights somewhat higher, one lamp may serve three or four persons; but those who sit behind get glare in their eyes, and the light at some distance to one side is weak. In indirect lighting both these sources of irritation are removed; the lighting is very uniform, without shadows to reduce the illumination below what it should be for work (the practical reduction by shadows in direct lighting being about 46 per cent., or in the shadow of the writing hand about 77 per cent.) Direct lighting is only to be recommended when the light comes from one side and is screened; this makes electric incandescents necessary, and these are too expensive. Besides, they give too sharp a contrast between the paper on the desk and the room at large. The best arrangement where direct lighting is used is shown in Fig. 1, which

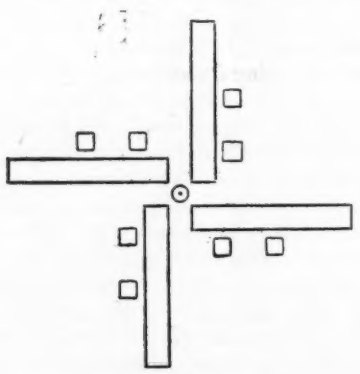


Fig. 1.

represents seats for eight scholars, the light being fairly high up. For daylight the benches would have to be shifted.

The loss of light in indirect lighting is not nearly as great as might be expected. With six Welsbachs in a room of 660 square feet floor area, direct lighting gave a best illumination of 25.3 meter-candles, a waste of 9.7, and an average of 17.5, while with indirect the figures were 19.1, 13.3 and 16.2 (Erismann). The illumination should be at least 10 meter-candles at every point. The general effect of indirect lighting is one of great comfort, though at first glance it does appear rather dim. Milk glass has been used for the reflecting screens in order to reduce the apparent contrast between the bright upper and the darker lower part of the walls of the room; when it is used, shadows are apparent, but very slightly so. Uhtoff has shown that with a light of $\frac{1}{12}$ meter-candle the sharpness of vision (daylight) is reduced to $\frac{1}{4}$, at 1 meter-candle to $\frac{1}{2}$, at 10 meter-candles to $\frac{4}{5}$, and is normal under an illumination of 100 meter-candles. "Pure" indirect lighting, with opaque reflectors, gives the best results in illumination when the ceiling and the upper third of the walls are kept matt white (painted every 2 or 3 years), the doors painted white and the windows covered with white blinds, and when the reflectors are kept clean. In a room of 30 feet by 20 feet, 50 scholars can have their desks well lit by pure indirect lighting from 6 Welsbachs, while direct lighting would require 10; "mixed" lighting (that is, indirect lighting with milk glass reflectors) would also require 10 Welsbachs, but these would give a better result than 10 used directly. With Welsbachs the predominant upthrow of the light is all in favor of indirect lighting. Pure indirect lighting is, however, not good for drawing from the model, in which case there should be sufficient shadows. Indirect lighting by arc lamps is better in very lofty rooms, 16 feet and more; and in this case the "mixed" lighting is better than the "pure" indirect lighting.

Gas v. Arc Lamps for Indirect Lighting.—Arc lamps do not vitiate the air and need less attendance than Welsbachs, and produce an effect more nearly the same as that of daylight. Welsbachs, on the other hand, give a steadier light than arcs, unless these are on an alternating current. The balance seems somewhat in favor of arc lamps for indirect lighting; the cost is higher, which is very important, but in some cases the cost is much the same as that of Welsbachs. Acetylene is clearly too dear. Whether arc lamps or Welsbachs should be used seems to depend on what fittings already exist, on the local prices of gas and current, on whether an alternating current is available or not, and on whether the attendance would have to be specially provided or could be undertaken by the existing staff of employees.

II.—Committee of Medical Faculty, University of Munich; Professor Eversbusch, chairman.—Generally agrees with Surgeon-General Seggel. In numerous university and hospital establishments, indirect lighting by Welsbachs, with inverted conical milk glass screens to throw up most of the light, has been introduced with very satisfactory results, as also in many Austrian schools. "Mixed" lighting of this kind is clearly quite applicable to different classes of work. Pure indirect lighting (with metallic reflectors) produces a more uniform illumination, but seems to require a greater number of burners, with a corresponding increase in heating and vitiation of the air, and is apt to lead to a neglect to keep the invisible reflecting surfaces bright and clean. For Welsbachs, "mixed" is practically as good as "pure" indirect lighting. The matt paint used for the ceilings may be of calcined magnesia. By-passes are of good advantage in connection with Welsbachs used in this way; the cost of the extra gas is covered by the saving in mantles. Lamps can be arranged with advantage so as to illuminate blackboards and maps without being themselves visible. An example of the arrangement of lights in a room is given in Fig. 2,

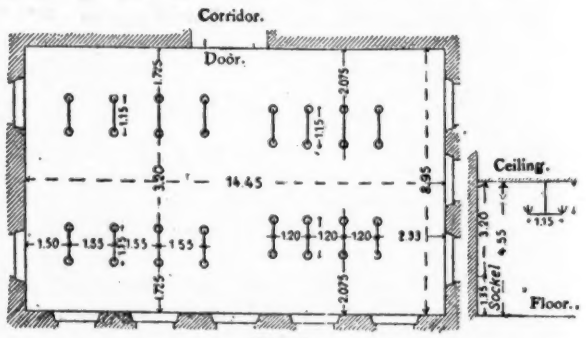


Fig. 2.

the hall of the Pharmacological Institute in Erlangen. Here the ceiling is painted with zinc white, and the walls (15 feet 2 inches high) are painted for the upper 10 feet 8 inches with white enamel and for the lower 4 feet 6 inches with brown oil paint. [In the original the measurements are given in metres, say, 40 inches.]

III.—Surgeon-General Seggel and Professor Eversbuch Jointly.—The only point of divergence being as to the relative advantages of "mixed" or "pure" indirect lighting, Professor Prausnitz went into the data afresh. He found that at high gas pressures "mixed" lighting gives the better results, and that metallic reflectors only maintain superiority over the "mixed" indirect lighting so long as the reflecting surfaces are kept bright. The general results of the investigation, finally, are:

1. Hygienically the consumption of oxygen and the formation of products, the liberation of heat, the radiation of heat upon the scholars and the glare of light into their eyes, should all be kept low; the light must be steady, and the illumination should be 10-meter candles for ordinary and 15 to 25 for fine work, without contrasts and uniformly distributed, all at a cost not too high.

2. For these ends, the best is "mixed" indirect lighting with Welsbachs in milk glass conical screens, upper diameter 10 inches, lower 2.4 inches, height 5 inches, in rooms at least 10 feet high, and, less advantageously, Welsbachs with conical metallic reflectors, polished or enamelled (upper opening 24 inches, angle 22°), in rooms above 13 feet 4 inches high. Welsbach lighting is the cheapest; and one Welsbach should be allowed per 66 to 132 square feet, according to the fineness of the work to be done, and hung at from 8 feet 4 inches to 11 feet 8 inches from the floor, according to the height of the room. Electric arc lamps, with metallic reflectors, come next if the current be alternating so that the light is steady; the light is very like daylight. In rooms more than 16 feet 8 inches high electric light is to be preferred. One 10-ampere lamp is to be allowed per 463 square feet; two 6-ampere lamps per 538 to 645 square feet. Welsbachs for direct lighting with screens to keep the direct glare out of the eyes may be used in rooms which are only partially used, where there are few scholars, or where there is drawing from models; and electric incandescent light may also be used under the same conditions, as it does not heat or vitiate the air and does not require as much attention as Welsbachs. Arc lamps, as compared with Welsbachs, produce no heat or products of combustion; but the use of gas favors attention being paid to ventilation.

The proprietors of the Annapolis (Md.) Gas Company have ordered a reduction in the selling rate, from $2 to $1.75 per 1,000 cubic feet. The concession takes effect the 1st prox.

Determining the Density of Smoke.

Engineering Record notes that among the interesting papers read at the recent convention of the New England Cotton Manufacturers' Association was one by Mr. Albert A. Cary, of New York, on smoke and the determination of its density. In beginning his discussion he referred at considerable length to the actual composition of the smoke given out by the chimneys of plants where bituminous coal is used as fuel. The main facts which he gave showed smoke to consist of (1) carbon particles escaping unconsumed and constituting the soot; (2) tar vapors, (3) steam, (4) particles of dust carried up mechanically by the draft. The proportions in which they are mixed depend on the condition of the surface of the fire. When fuel is first put on, tar vapor and steam escape from the fire below, together with the products of complete and incomplete combustion, as Professor Lewes has pointed out. As the heat works upward through the new fuel, the products of distillation from the coal catch fire and are partially burned, the carbon or soot in the smoke resulting. As the fire burns clearer and clearer and the upper portions become incandescent, practically nothing but the products of complete combustion find their way up the chimney.

The only accurate method for determining the amount of carbon, tar and dirt in smoke which is mentioned by Mr. Cary is to weigh the solids in a measured quantity of smoke drawn from the boiler outlet, a process which is, of course, beyond the resources of the practicing engineer. The practical methods involve some kind of comparison.

In some cases plates have been hung for definite periods of time in the path of the escaping products of combustion; the plates can be smeared with a sticky substance to catch all the particles in the gases, or the sticky tar can be relied upon alone to cause the particles to adhere to the plates. By placing the plates in the flue during the different conditions under investigation, a nd then comparing their appearance and the weight of the solids collected on them, some idea of the relative amounts of smoke given off can be obtained.

The camera has been used in such work, but gives misleading results. The shades produced on the prints are influenced by the position of the camera respecting the sun, the clouds and the method of developing the negative and making the print, so that the effect of the smoke may be eliminated by other causes in the final photograph.

The Prussian Smoke Commission of 1894 employed a photometric instrument. One leg of the apparatus was set so that it enabled the observer to see through the smoke laden gases in the boiler flue, while the other leg was directed at a standard candle in the usual manner.

The direct observation of the smoke as it issues from a chimney and the comparison of its shade with some arbitrary scale together form the usual method of determination at the present time. Many causes affect the values assigned to any particular smoke by the observer, such as the relative positions of the sun, the chimney and the observer, and the cloudiness of the sky. As it is almost impossible to avoid comparing the smoke with its background, it is desirable to have all observations made from the same position as respects the sun and with the same amount of clouds behind the chimney.

The various scales proposed from time to time by which to measure the shade of smoke are very numerous. The gradations between a dense black opaque smoke and the invisible vapor which all boiler attendants wish to attain have been grouped by different observers in 3, 4, 5, 6 or 10 divisions. Mr. Cary states that he has found a scale of 5 or 6 degrees will express with sufficient clearness the shades of appearance which it is desirable to record, and at the same time the differences between these degrees are not too fine to prevent easy and rapid determinations.

Among the devices employed to assist the observer in determining the density of smoke, is one consisting of a tube into which a number of pieces of smoked glass can be dropped one after the other. The outer closed end of this tube is provided with a plane mirror set at 45° so as to reflect light from above through the pieces of glass. By placing the tube to one eye and using the other to watch the chimney, it is possible to obtain a fair comparison and measure of the smoke. Another device which Mr. Cary mentioned is a triangular prism having two of its sides of glass and the remaining parts of metal. The interior is filled with water or alcohol colored black, and the observer looks through the two glass sides across the prism along lines parallel with the base. By shifting the line of sight from the apex downward it is possible to obtain as many shades as desired, and to express the desired shade by the ratio of the thickness of the prism at the line of sight to thickness of the base.

Two forms of charts have also been employed in estimating the shade of smoke. That originated by Professor Ringelman, of Paris, comprising six rectangles cross-sectioned with lines of various widths and spacings. The character of the lines proposed by the originator of the chart is as follows:

No.	Black Lines.	Spacing.
0	All white	.....
1	1.0 millimeter thick	9.0 millimeter
2	2.3 " "	7.7 "
3	3.7 " "	6.3 "
4	5.5 " "	4.5 "
5	All black	.....

With a scale constructed according to these directions, Mr. Cary states, the observer will be obliged to place the chart over 60 feet away in order to obtain a blending of the lines into the desired tints. For that reason, similar charts in several American reports and books have been plotted on half the scale originally advised. The late Bryan Donkin modified this scale by substituting for the cross-hatching uniform flat washes of gray, the tints corresponding with the effect of the shading on the rectangles of the older chart. The Donkin chart can be placed close to the observer and employed on this account in situations where the Ringelman chart is useless.

Smoke determinations should be made at frequent and regular intervals, every half minute being a good period for this purpose. On important tests it is desirable to employ two independent observers. At the same time somebody in the boiler room should note the time of each firing and cleaning and any other conditions likely to influence the amount of smoke, such as forcing the boilers, running light and the like. If analyses of the gases are also made and the results recorded in connection with the exact time when the samples were taken, it will be possible to make a fairly satisfactory investigation of the conditions influencing the production of smoke in the plant.

A simple form of chronograph has been employed in France for plotting the results of the observations. A sheet of paper is wrapped about a cylinder driven by clockwork, so that a given distance along one edge of the paper represents a period of one minute. A pencil pressing against the face of the paper can be moved from one end of the cylinder to the other by the operator, its position at any instant being such that its distance from one side of the paper is a measure of the operator's estimate of the shade of smoke at the time. Mr. Cary's paper contains illustrations of an improved form of this apparatus which he has employed in his work.

Chicago Discussion of Central Station Tendencies.

Electrical World reports that at the meeting of the Chicago branch of the A. I. E. E. on May 5, the papers on "Tendencies of Modern Central Station Development," which had been presented at the New York meeting of April 24, came up for discussion. Mr. Peter Junkersfeld, recently elected local Secretary, presided. A well attended meeting attested to the importance of the subject and the great number interested in this branch of electrical engineering. The papers were abstracted, that on "Economical and Safe Limits in Size of Central Stations," written by H. A. Lardner, by Prof. P. B. Woodworth, that on "Safety Devices in Central Stations and Sub-stations," by Philip Torchio, by W. G. Carleton, and that on "Multiple versus Independent Operation of Units and Central Stations," by Peter Junkersfeld, the writer, himself. The discussion, which was participated in by many, brought out several important points, both in the construction and the operation of power plants.

Bion J. Arnold stated that he had always been inclined, as was well known, to the use of a single power house where this could be properly located as regards the supply of fuel, water, etc., with sub-stations operated by rotary converters. As regards the use of motor generators versus rotary converters, European practice seemed to be the opposite of ideas generally accepted here. On a recent visit to Frankfort, Germany, he saw in operation a 1,000-kw. motor generator set. The motor was a single phase one, although he had been assured previously that such a size was not feasible. Those on the Continent claim that a better efficiency can be obtained from the motor generator combination, or at least as low a cost of operation, as with rotary converters. This is because the generators are wound for a high voltage, and the motors work at the same potential, thus obviating the first cost—the expense of operation, the complication of step-up and step-down transformers and the necessary auxiliary apparatus.

As to the supply of current to a long line of railroad, he had modified some of his previous views as to the desirability and economy of one large alternating current power house for a long length of road and had been forced to the conclusion that for a railroad with heavy traffic, a number of direct current power houses scattered along the line were best.

W. L. Abbott, chief operating engineer of the Chicago Edison Company, called attention to an important problem in central station operation. To the operating man, a single day's supply of coal for such a plant involves no little thought. The supply of 1,000 tons of coal a day, as for instance to the Harrison street station of the Chicago Edison Company, is no small matter. He called attention to the different operating conditions resulting from the use of different methods of handling coal which had been introduced successively as the output of the former station increased. At first fuel oil was used. Then coal, which was brought to the boiler room in wheelbarrows. This was followed by the dump cart drawn by a horse, which in turn was superseded by the tramway and push car. All of these different methods have given way to modern coal handling apparatus. When one considers that under the first method the cost of handling a ton of coal was approximately 40 cents, whereas now it is between 15 and 20 cents per ton, although this amount is still far greater than it ought to be, this will be seen to be an important item, especially when one considers that the daily average consumption is 600 tons. A saving of 10 cents per ton would be a material one, and is very satisfactory indeed when the amount handled is considered. The continuous supply of coal for one of the large modern central stations becomes a serious problem when one considers that the consumption of 3,000 tons of coal per day is the equivalent of two train loads. In large cities, where the congested condition of tracks causes irregularity in supply, no reliance can be placed upon the railroads. This irregularity of supply is further increased at the mines. As a station must be operated continuously, regardless of any irregularity in the coal supply, it becomes self-evident that ample facilities for the storage and the handling of coal must be supplied, and the advisability of the company having special terminal facilities as well as owning its own cars is not to be disregarded. It is self evident that the handling of such a large amount of coal and ashes by hand is impossible, and that apparatus must be installed obviating the handling of the coal by workmen, not only because of the decreased cost, but also because it reduces the number of employees, and what is still more important, the possibility of trouble because of labor agitation. In cities where several power houses are located it is most economical to operate one large power house only.

Storage batteries are valuable adjuncts for these, as they meet sudden demands for power made on the power house because of sudden changes in the weather or because of a breakdown at some station. The same may be accomplished to some extent by hand-fired furnaces, but this is impossible with automatic stokers. A great many power houses are now being built with apparatus for producing forced draft, as the draft may suddenly be doubled or even quadrupled, and the output increased to that extent, otherwise there would be a serious drop in the steam pressure where such a sudden demand is made. As a general thing, it may be said that the most wasteful and most extravagant piece of apparatus and the one which receives the least attention, is the boiler. At times a waste as much as 50 per cent. of the fuel used can be charged to the boiler, although half of this is quite readily prevented. As a consequence, it is necessary that the operating engineer give the closest attention to the boiler room. This is quite apparent in a plant consuming $3,000 or $4,000 worth of fuel a day, as a saving of 5 per cent. would be of great interest to those paying the bills.

In a general discussion which followed, Mr. Junkersfeld called attention to a number of interesting points which had been brought out in the discussion. He said that he was very much interested in the remarks made by Mr. B. J. Arnold concerning his conclusions that for railroad operation the best plan was to have direct current power houses at frequent intervals rather than large alternating current stations every 20, 30 or 40 miles, depending upon the size of the plant. It seemed to him that in the case of such plants, the element of unproductive investment and of unproductive labor would make it desirable to have as few a number of these as possible, provided they were located within the economical limits of voltage, and possibly it would be well to have the plants further apart. He also called attention to the fact that the boiler room was not receiving its due share of attention as regards either design or operation. The boiler room investment amounted to quite an appreciable percentage of the total amount. Another important point in central station design which had been brought out in the discussion was the fact that storage batteries, although having a field of their own, could be superseded to quite an extent by the judicious use of forced draft in the boiler room. Quite an appreciable amount of storage battery capacity could be obtained at a reduced cost in this manner.

H. B. Gear, General Inspector of the Chicago Edison and the Commonwealth Companies, called attention to the question of isolation or central control carried out through the 60-cycle distributing systems of both companies. The average feeders are carried along different routes, so that in case of trouble at any one point, other sections of the city are not affected. The same is true with the secondary system. Each transformer supplies a separate secondary system. The main secondaries are not more than 500 or 800 feet long, and are supplied by two or three transformers at the most.

W. G. Carleton, assistant to the chief operating engineer of the Chicago Edison, discussed the troubles he had experienced on the 25-cycle distribution system. His experience had been the same as that of Mr. Torchio. Three-quarters of his trouble have occurred in the station, and were mechanical. The faults on the 9,000-volt lines were not due to any inherent weakness, but rather to mechanical injuries. He considered it advisable to separate the routes of different lines, even though they were operating in parallel at the stations. He referred to trouble which the company had experienced with currents going two or three miles along the lead sheath of the cables, and that this had been obviated by breaking the lead sheaths every half mile or so, and grounding them at the middle points.

J. R. Cravath stated that he had been impressed in looking over recent plans for turbine stations, with the enormous amount of boiler room required for one turbine unit. As one engineer had expressed it, power houses would almost have to be installed on the radial plan with the turbine in the middle. The relative location of boiler and turbine rooms to keep down the distances steam must be piped and provide for extension section by section on a uniform plan, is a serious problem in the design of such stations.

Bion J. Arnold, in reply to the remarks of Mr. Junkersfeld, then said that in advocating direct current power houses located short distances apart, he had in mind heavy railroad service with trains requiring 1,500 kw, as for instance, on the New York Central.

The Manufacture of Incandescent Electric Lamps in England.[1]

One of the most satisfactory examples of the way in which inventions grow and produce new industries is that of the manufacture of the incandescent electric lamp. An admirable example is found in the works of the Sir Hiram Maxim Electrical and Engineering Company, of Gillingham street, Victoria street, S. W., an establishment we now propose to describe. Before proceeding to do so, however, it will be appropriate if we give a few details of the early history of this means of artificial illumination; for although the incandescent lamp has only been before the general public for the last 25 years, it is a much older thing than is generally imagined.

In 1841 a specification was filed by Frederic de Moleyns, of Cheltenham, for means of obtaining illumination by the use of an electric current and the incandescence of a platinum wire, aided by a falling stream of charcoal or plumbago particles. There was a glass globe which could be exhausted. Incandescence was not, however, the only source of light, as there was provision for moving the platinum wires apart, and maintaining a circuit by a number of minute arcs formed between the particles of falling carbon. A device approximating more closely to the lamp of the present day was that invented by Mr. J. W. Starr, of Cincinnati, but patented by one King, who appears to have exploited the inventive genius of the young American. A thin strip of graphite was held between two clamps, the whole being suspended by a platinum wire sealed into a globe. This globe was blown on to the upper end of a barometer tube of more than 31 inches in height, and was filled with mercury in the usual way, thus producing a Torricellian vacuum. Current was taken through the carbon conductor, heating it to incandescence, and passed through the column of mercury, which was included in the circuit. Mr. Mattieu Williams has given an interesting account of these early experiments, which date from as far back as 1846. It would appear from his statement that not only platinum, but alloys of platinum and iridium, were first tried and abandoned. Experiments were then made with many forms of carbon, including even burnt cane. The similarity between these experiments and those conducted so many years after by Edison will be apparent. All these forms were, however, abandoned in favor of hard gas retort carbon, which was cut into thin sticks. The apparatus was exhibited by Mr. Williams in the Town Hall of Birmingham, and at the Midland Institute. It is said that the only difficulty met with was due to a slight volatilization of the carbon, and its deposition as a brown film upon the lamp glass.

Other more recent inventions will be within the memory of many of our readers. Elaborate devices of many kinds were brought forward,

1. *Engineering.*

and it may be said that the practice of more recent years has been in the direction of simplification; in this respect progress in this field has followed the course of most inventions leading to industrial processes. An account of these early lamps will be found in "Electric Illumination," published at the office of *Engineering* in 1882, and consisting chiefly of articles reprinted from our columns.

One of the most recent establishments for the manufacture of incandescent lamps is that founded by Sir Hiram Maxim, and to which we have already referred. It is now 25 years since Sir Hiram began the study of incandescent electric lighting, and he claims to be the first to have electrically heated carbon rods or filaments in an atmosphere of hydrocarbon vapors, a process at present known as "flashing." We recently had an opportunity of inspecting these works, and now propose to give the results of our investigation.

In natural order, the first process to be described is the manufacture of the filament itself. This is composed of carbonized cellulose. The Cellulose is obtained from Japanese paper or other materials, and is first seen by the visitor in the works in the shape of a thick solution, not unlike clear golden syrup treacle in appearance. There are several processes of dissolving the cellulose, most makers having their own formulæ, which are, we believe, invariably kept as a secret. The solution when made is placed in small glass holders or flasks having openings in the bottom. In these openings are placed pierced stoppers or dies, of sapphire, the holes being of suitable size for producing films of the right diameter. Compressed air is admitted above the liquid, and thus forces the latter out through the holes into glass cylinders containing a prepared setting fluid, composed chiefly of methylated spirit. The fluid is made of various strengths, in order to produce the desired result for different descriptions of filaments.

The chief object is to get a perfectly even thread, and that depends both on the nature of the cellulose solution itself and the bath into which it is coiled as it descends from the glass holder. It will be easily understood that if the cellulose solution is not perfectly homogeneous—that is to say, if it is of slightly varying consistency—there is a tendency to make an irregular thread. A good deal of special chemical knowledge is needed in the production of the cellulose solution, as well as the greatest care in making it, more especially in regard to temperature and the time occupied in the preparation. Very pure cellulose must be employed, and any grit is fatal to the success of the undertaking. The pressure of the air which forces the cellulose solution from the glass holder must also be carefully regulated.

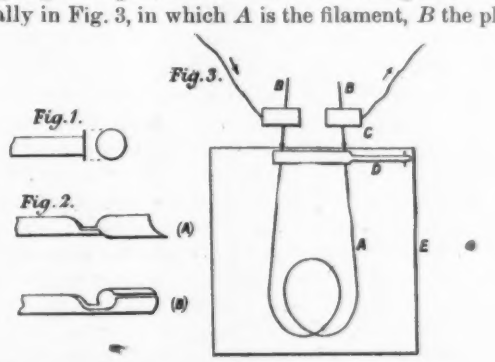
The filament, as it emerges through the sapphire die or stopper, coils itself with great regularity in the vessel containing the setting solution, and these coils may be 20 to 30 yards long, or even more, according to the diameter of the filaments. When a sufficient length has been produced, it is taken out of the spirit, it having become sufficiently hard to have a fair amount of tenacity, so that it can be easily handled. It is then placed in other hardening and purifying solutions. The coils are then dried in air and wound into hanks. The next process is to cut the lengths required for forming the filament, as seen in the incandescent lamp, allowing for a certain amount for wastage during the process of manufacture. The filament has now very much the appearance of thin catgut; some of it, however, is so fine as to be more like white horsehair. It has considerable tenacity, and is broken with some difficulty. For lamps of different voltage different thicknesses of filament are needed.

Bundles of filament of the required length are now taken and wound on to a carbon block, so as to give the loop with which all are familiar, as seen in the incandescent lamp. The blocks, with the filaments wound on them, are packed into plumbago crucibles for the next operation, which is carbonization. This is carried out by placing the blocks, with the filaments on them, in a furnace heated to a very high temperature; air, of course, being excluded. The carbonizing being complete, the blocks are removed from the furnace, and the film then retains its shape. It is remarkable how elastic these fine threads of carbon become; they can be pulled out perfectly straight, and will spring back at once to their original form. The carbonizing furnace is of the regenerative type, the air for combustion being brought through brickwork passages. The time occupied in carbonization is about twenty-four hours. Before the filaments are placed on the blocks they are tested most accurately for diameter by micrometer gauges, and the same process is gone through after carbonization. Finally, the various filaments are carefully sorted according to the voltage and the candle-power for which they are suitable.

We now pass to the mechanical department of the works, which is, it need hardly be said, driven by electricity. The firm generate their own continuous current, but the alternating current, which forms the bulk of the power, is obtained from the London Electric Supply Company's mains. After the filaments have been formed as described, the first operation is to attach them to the short lengths of platinum wire which pass through the glass bulb of the lamp in order to form electrical connection between the wire system and the filament. Platinum is the only material that can be used for this purpose, for it will not only withstand the heat of the blow-pipe in melting the glass round it, but, what is of equal importance, it has the same coefficient of expansion under heat as glass. As its value is about $21 per ounce, it will be easily understood that great care is required to prevent waste, and an ingenious machine has been devised to cut the pieces to the required length, the mechanism working within a limit of one-thousandth of an inch of accuracy. As short lengths are cut off, a head is formed on them, as shown in Fig. 1. This is known as a "butt-headed stem." The machine is of Sir Hiram's own design, and will cut 200 lengths per minute. The wire is fed by a ratchet arrangement, the lengths to be cut off being determined by the distance the ratchet travels over a toothed wheel. This is worked by an eccentric on the main shaft. The machine is automatic in all its actions, and is operated by a series cams. The wire is fed to the required distance, and is gripped by a suitable mechanism as the feed stops. A hammer then punches the head, and the wire is fed through to the exact length, and is cut off by knives, a small piece of the main coil being left in front of the die ready to come up and be punched into the the next head. Sometimes, with a very fine filament, no head is made on the platinum stems, but the end of the wire is formed as a tube. At the time of our visit these minute tubes were being cut for stems of .008 inch, to be used for filaments as fine as .002 inch in diameter. The way in which the tube is formed is by flattening the end of the wire by the blow of a hammer, as shown by *A* in Fig. 2; the part is then drawn through a sapphire die in a hand machine, as shown by *B* in Fig. 2. One girl can do a thousand of these in an hour.

We now pass to the sorting and gauging department, where the films are divided out according to diameter; they are gauged to one ten-thousandth of an inch. The operators, who are girls, unwind the filaments, taking about 100 in a bunch, and separate them out with great dexterity. As stated, the filaments are very flexible, and it is possible to take a 4-loop filament and pull it out perfectly straight; if the carbon is pure, it will spring back into its original form. The carbon breaks with a very sharp metallic sound, like the snapping of glass.

In the depositing room the carbon filaments are joined to the platinum points. It is largely in this operation that a high class lamp differs from one of the commoner and cheaper manufacture, many of the latter being of foreign origin. The easier and cheaper way is to stick the filament and the points together with a carbon paste. That will contain air, which will remain after the bulb is exhausted, and will lead to the disintegration of the carbon, and to the consequent blackening of the bulb by a deposit of fine carbon. The better way, and that invariably followed at these works, is to deposit carbon round the part where the filament joins the platinum stem. This is done by a machine which was invented by Sir Hiram Maxim. The stems are first placed in clips on a pair of balanced arms, and the filament is laid on a vulcanized fiber table, it being so arranged that the ends of both stems and filaments coincide. Held in these clips, the whole is lowered into a bath of benzoline. A conductor or short circuiting piece is attached, so as to take the current direct from one joint to the other, and thus avoid its going through the filament. The arrangement is shown diagrammatically in Fig. 3, in which *A* is the filament, *B* the platinum



wires, *C* the clip for holding the wires, *D* the short circuiting piece, and *E* the vulcanized fiber table. Current is sent through the platinum points and the filament by means of an adjustable resistance. There is resistance at the part where the carbon filament and the platinum point abut, and this raises the temperature. As the whole is immersed in liquid, a vapor is first formed and then condenses as solid carbon, the

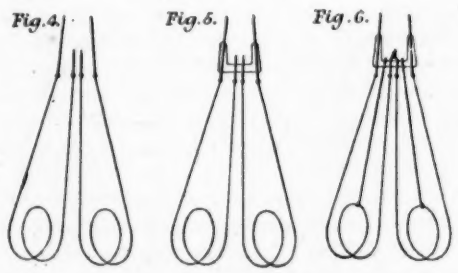
action being intermittent. In this way the platinum and the end of the filament are joined by what looks very like a plumber's wiped joint. Naturally, the whole apparatus has to be well immersed in the liquid so as to prevent air getting to it; otherwise the highly inflammable vapor would at once flash into flame. No accidents have occurred through this up to the present time, but precautions are taken to prevent fire. All the fittings are of iron and slate. Boxes are provided to cover the whole apparatus up and exclude air, if necessary, in case of accident. Arrangements are also made so that the benzoline liquid used could be run out of the holding tank at once, a complete system of pipes being laid for the purpose. Moreover, all the filling of the various machines is carried out by means of pipes, so that none is carried about in the room.

The points being attached to the filament in this way, the work is examined in order to find out if the operations have been successfully carried out; indeed, throughout the process of manufacture a point is made of careful inspection at each stage.

The treating or flashing of the filaments is the next process, and the department in which this is carried out is one of the most important in the manufacture. Flashing adds greatly to the efficiency of the lamp, and is one of the chief features that distinguishes high-class work from that of a cheaper nature. The object is to build up the carbon so as to make it absolutely uniform throughout the filament. This was a difficulty that long worried the early workers in the field of incandescent lamp manufacture and invention. The trouble was to get a homogeneous filament of equal section, even when much larger filaments were employed than are now used. One of the processes used in early days, in order to obtain homogeneity, was to saturate the carbon in melted gum or saccharine solution, and afterwards to bake it. It was evident that, in such a way, the very fine results reached in practical work by the process we are about to describe could not be obtained, and, indeed, the early experiments were so unsatisfactory that carbon had to be abandoned for a time in favor of platinum wire, which, however, also had its drawbacks.

In the process now followed the filament is put into two glass flasks, which are used alternately, and into each of these, as it is used, the attendant introduces a dash of spirit by means of a mop. The reason for having two flasks will be explained later. The flask being exhausted, the reduction of pressure causes the hydrocarbon liquid to become vapor. A powerful current, about twice that which would be used in practice, is then sent through the filament. If there is a thin place, the filament will naturally glow there more strongly, the resistance being greater, and the vapor will therefore deposit carbon more rapidly at that spot. In this way the section of the carbon is equalized within very fine degrees of accuracy. There is an automatic cut-out device to stop the process when the resistance is uniform, and the filament therefore of uniform section throughout. This device consists of a solenoid which breaks contact when the resistance of the filament is brought to the desired point. This is reached when the filament is of the proper resistance and of uniform section throughout. Another advantage of this process is that if the filament should be slightly out in regard to length, the thickness would be built up until the correct resistance was attained. This, perhaps, is a refinement of practice, as the mechanism for cutting the filament is extremely accurate, but it does have the effect of correcting any error in length, should it exist. The object of having two flasks is to reduce the work of producing the vacuum. In order to take out the filament, the flask has, naturally, to be opened, and air enters. Before one flask is opened, however, it is put in communication with its fellow, and, in this way, the first air admitted is taken from the other flask. This will give a vacuum in both flasks equal to half the atmospheric pressure (supposing, of course, a perfect vacuum were obtained), and when the second flask has to be used there will be but a small volume of air to be removed, and the work of the air pump is reduced to one half what it otherwise would be. As a very high voltage is sent through the filament for the purpose of causing the carbon deposit, the filament glows too brightly to allow any irregularities that might remain in the section of the filament to be observed. The operator, therefore, as a test before taking out the filament, passes through it a current of lower voltage, and is thus able to see if there are any bright spots such as would indicate that the process was not complete. In this room there is a transformer, by means of which any voltage needed may be secured.

We now pass to the glass-blowing department, where special lamps, such as "crinkles," "half-opals," and unusual forms of bulbs are made. This department is operated entirely by men. Many forms of lamps are used; for instance, there are bulbs, the top of which is of opal glass, in order to throw the light down. High candle power lamps are also made here; these have to be carefully annealed. Crucibles are mounted on radial arms on a standard, there being a Bunsen burner, giving a constant heat. The arms revolve, and by the time each crucible comes round to the lamp again the bulb has been cooled down at the rate needed. It is necessary now to put the filament with its stems, as described, into the lamp. This is done in the department known as the "sealing room." Very steady hands and high skill are needed for these operations. For high voltage double filament lamps, nickel wire supports have to be inserted; and this is especially the case for lamps used in a horizontal position, as the filaments would gradually drop were they not held in position. Supports are also required where lamps are used near machinery, or when from any other cause vibration arises; otherwise the filaments may interlock, and short-circuiting would thus be set up. In Fig. 6 a double filament with supports is shown, the platinum wires being the straight part going from the bend of the loop to the glass bridge. For the purpose of attaching these supports, the filament with the platinum stems attached, as shown in Fig. 4, is placed in a holder, together with the supports. A plate then comes down and fixes the whole in position, the ends of the supports and the stems projecting. Fine glass tubes are then placed on the platinum stems. A piece of plain glass is melted round the whole by by means of a blow pipe, so that it forms one piece, being fused together with the fine glass tubes, as shown in Fig. 5, by which it will be seen that the platinum points and nickel wire supports are embedded in the glass bridge. The latter is subsequently melted into the bulb of the lamp. This operation, it should be stated, is carried out before the filaments are flashed in the manner already described. The platinum supports are attached to the filaments by loops. It is comparatively easy to form a single loop, but it is more difficult to make a double turn, which is the shape needed. It will be easily seen that with a single curve, vibration would cause the filament to shake off, but it will not do so with the double turn. An ingenious little machine is used for this purpose. The wire is threaded through a guiding hole, and passes on to a needle which runs in a sleeve. The needle is stationary, but the sleeve is revolved by a handle, and has on the end of it a little catch, which carries the wire round. The ends of the center pair of points are twisted together, as shown in Fig. 6.



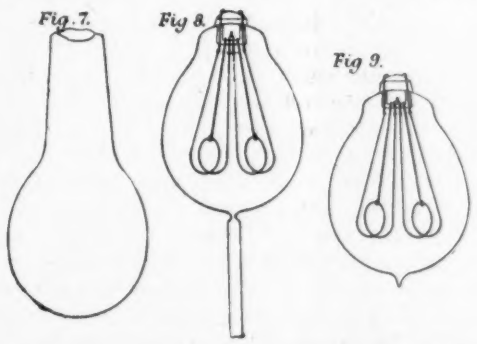
The next operation in the making of the lamp is to place the filament, mounted as described, inside the glass bulb, shown in Fig. 7. The end of the neck is put into the flame and opened, and the filament is put inside the bulb. The operator, generally a girl, then places the neck, or end of the lamp, in the gas flame, the filament being loose inside, and makes the end of the glass bulb plastic. She turns the bulb up on end, when the weight of the filament will cause the platinum ends to come through the still plastic glass. She then nips the whole together, the glass bridge, which has been melted on to the platinum points, being fused into the glass bulb. This end of the lamp is then sealed up, and the filament is in place, with the platinum points projecting through the glass, as shown in Fig. 8. The platinum points are then bent over into loops for the purpose of attachment. In forming this end of the lamp, the glass is nipped into a curve, so that the plaster which has afterwards to be put on will go well into it, and the two will not come apart. After this treatment in the Bunsen flame the glass has to be annealed, and this is done in crucibles carried on a turntable with radial arms, the cooling down being gradually effected as the turntable revolves. Care has to be taken in this process, and draughts in the room must be avoided, otherwise the glass would be chilled and become brittle. In some lamps the filament has to be anchored from the side. In order to do this the bulb has to be melted, and short lengths of nickel wire inserted. These supports have hooks at the end, which engage with the filaments. The end of the support is held to the glass bulb, which has to be melted up round it. The surplus glass is taken off while it is hot, and all is made smooth. This is very pretty work, and is skilfully performed by the girls who carry out these operations.

The important process of exhausting the bulb of air has now to be

carried out, and a special department is devoted to this. There has been attached a glass tube to the end of the bulb, as shown in Fig. 8. It is by this tube that the bulb is handled, and through it the air is exhausted. These tubes are melted on by girls, and considerable skill is needed to get them straight in position. With practice the operators arrive at such perfection that the bulb and tube are as coaxially true as if turned in a lathe. This exhaustion of the air is a very important process, as, naturally, the life of the lamp depends on the approach to perfect vacuum which is reached. There are many ways of carrying out the process, but only one is followed in these works. In some factories exhaustion is effected by a combined chemical and mechanical process, the air being abstracted as far as possible by ordinary means, after which that which remains is decomposed by chemicals. This is a cheap method, but is not considered as efficient as the purely mechanical process, and consequently the lamps are found not to last long. Sometimes cheap lamps, especially those of foreign make, large numbers of which are sold in the present day, are only mechanically exhausted as far as the pumps will take away the air. This, of course, is an imperfect method, and the bulb blackens very quickly, whilst the candle power soon goes down. In the Maxim works the following process is used: The lamps are placed in long frames which hold a large number, and they are melted on to glass tubes held in the frames by T-pieces connected with 2-way cocks. One branch from the 2-way cocks leads to the mechanical pumps, the other branch being connected with mercury elevators. The pumps are of the Geryk type, which will produce a vacuum to all appearances equal to the barometer. When the pumps have done all that is possible, the 2-way cock is turned so as to put the bulb in communication with the mercury system. This consists of a large number of vertical tubes, down which the mercury is caused to flow. As the mercury falls it carries the air in the tube with it, thus improving the vacuum and gradually exhausting the lamp bulb to as near an approach to absolute vacuum as it is possible to get. It is very easy to see when the bulb is quite free from air. At first, although the bulb has been exhausted, as stated, a good deal of air can be seen going down with the mercury in the vertical glass tubes. Gradually this gets less and less, until at last there is nothing to be seen but a solid column of mercury flowing down. Naturally, the whole exhaustion can be carried out by the descending mercury column, but this would take a long time, and the Geryk pumps are, therefore, used, for the first part of the process. The mercury has, of course, to be lifted again to the top of the frame for further use, and some special pumps have been devised for this purpose. The whole of the plant has been designed by Sir Hiram Maxim, and forms a special feature in this process of making incandescent lamps.

When the vacuum in the bulb has been completed in the manner described, and before the lamps are melted out from the frame, current of 8 to 10 per cent. higher voltage than that which will be used in practice is put on. At the same time a ring of gas jets raises the temperature of the lamp to a very high point. If any moisture is in the lamp it will then be carried away by the descending mercury column. There is also inserted in the system of glass pipes on the frame a flask with phosphoric acid, that assists to absorb moisture.

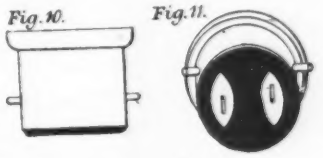
It may be pointed out that in this process all the lamps are melted on to the glass tubes, so as to insure a perfect vacuum, and they have ultimately to be broken off. An easier system, often followed by the cheaper makers, is to attach the lamps to the mercury tubes by means of india-rubber pipes; but this is by no means a sure method of securing vacuum. After the lamps have been run in the frame, whilst attached to the glass tubes of the mercury system, for half an hour or more, they are "sealed off." This consists of melting the end of the tube attached to the bulb and working it up to the point shown in Fig. 9, which shows



the completed lamp without its cap. Economy of production may be secured by omitting the process of testing with the lamps attached to the glass tubes: or it may be of very short duration. To keep the lamps in position for some time with the current on naturally requires larger plant. After the lamps have been removed from the frames, a further test is carried out by putting them in gas ovens, to see if any air may have remained in spite of the precautions taken. The lamps are placed in a tray on an iron plate. The plate is connected to one pole of the high intensity side of an induction coil, and the operator takes a glass tube with a wet mop, which is connected with the other pole of the induction coil. The high potential will then illuminate any air that may be left. With a poor vacuum a red glow will be obtained, but with a fairly good one there will be a blue glow; whilst with lamps that have a thoroughly satisfactory vacuum nothing is seen. The test, of course, is carried out in a dark room.

In the photometer room every lamp is further tested separately by being put in the apparatus and run at the voltage for which it is intended. The current that it takes to give a certain candle power, which is measured by the grease-spot photometer, is ascertained by an ammeter. There is in the photometric department a Vernon-Harcourt standard pentane photometer. This is arranged to burn a given amount of pentane gas with a given volume of air at a known pressure. In this way the standard of light is known. It should be noted here that there is some discrepancy between the Continental practice and that of this country in regard to candle power. The 16-candle power Continental lamp equals not very much over 14-candle power of the British standard. Purchasers of lamps should know, therefore, whether they are buying on the Continental or the British standard.

The lamp is so far complete that it is an illuminating instrument, but for practical use a good deal yet has to be done to it. It has been said that the platinum stems are bent over in loops, and the next process is to put a tinned copper wire through the loops. The wires are twisted round and soldered, the ends being ready to go through the plaster which is contained in the brass cap, illustrated in Figs. 10 and 11.



The connecting wire between the platinum loops and the two poles on the cap is threaded through brass plates and bedded in vitrite, which forms a cover to the cap, and which stands well up above the outer liner so as to prevent short circuiting between the poles of the cap and the brass liner. This is an important point in regard to danger from fire. The lamps are then dried for 3 or 4 days, and afterwards put in a hot cupboard. The wires are subsequently cut off to short ends, and turned over into the recesses in the contacts, and soldered down. The marking of the name and voltage of the lamp is done by putting the words or figures on with a rubber stamp, but in place of ink a certain jelly is used. The characters being thus marked on the glass by the jelly, an acid powder is dusted on. This is held by the jelly and eats into the glass, leaving a dull surface; the acid does not take above 5 minutes or so to produce the desired result. Bulbs can be made with the top or the bottom part obscured, but this is done by the sand blast machine. If the lower part is obscured, the light is reflected on the ceiling, or the top part may be obscured so as to reflect the light downwards from the glass itself. Sometimes the obscuration is done vertically, so that the observer may be shielded from the light, which is reflected more brightly to another part of the room.

Mr. A. W. Hill is the manager of the works, Mr. J. Harrington being the assistant manager.

The Comparative Duration of Horizontal and Inclined Retorts.

The *Journal of Gas Lighting* notes that an exceedingly interesting return regarding the life of retorts has been made to the Edinburgh and Leith Gas Commissioners by Mr. W. R. Herring, the Engineer. The particulars have been compiled from the books of the Commissioners, recording the life and the work done by each individual setting during the whole time that the gas undertaking has been in the hands of the Commissioners. The statement proceeds: "The average life in days is arrived at by summing up the different periods during which each setting was in actual work. To obtain a fair average as to the work done by each retort, the engineer ascertained the total lengths of retorts that had been purchased since the undertakings were acquired in August, 1888.

This was divided by the total tons of coal carbonized during the same period, in order to arrive at the quantity carbonized during its life in the settings. No account is taken of the ordinary repairs, such as the cutting out of choked gas and air ports, the repair of the combustion chambers, and the renewal of parts of the retorts and settings. These are common, more or less, to all settings during the period of their normal life."

Comparative Statement Showing the Duration of Retorts and Settings at the Respective Works.

	Edinburgh.	Leith.	Edinburgh (Inclines.)	Granton.
Average duration.....	354 days	340 days	782 days (Still in working order.)	The Granton settings are built on exactly the same model as the New Street inclined settings; and there is nothing to show, after 180 days, that they will not be equally as satisfactory as those at New St., Edinburgh.
Retorts purchased since Commissioners acquired undertaking..	39,285 feet	25,714 feet	360 feet	
Coal carbonized same period....	Tons. 1,398,193	Tons. 696,938	Tons. 24,150	
Coal carbonized per ft. of retort.....	35	27	67	
Coal carbonized per retort...	315	244	1,341	
Coal carbonized per 20-feet retort.....	700	542	1,341	

Transmission of Power by Gas.

Some weeks ago, on the occasion of a visit to the Metropolitan Carriage Works, Birmingham, England, by many of the members of the Birmingham Section of the Institution of Electrical Engineers, with the object of inspecting the 250-brake horse power gas engines of the Westinghouse type installed on the works for the purpose of actuating two-phase alternators in parallel, a paper with the above title was read by Prof. F. W. Burstall.

The author in introducing his theme referred to the proposal made by the late Sir William Siemens some years ago, to transmit power over comparatively long distances by means of gas under pressure. No attempt was made to bring his scheme to a successful issue; but the development of the system of distributing power over large areas by high tension currents had caused attention to be again directed to the subject. Granting that some suitable cheap gas could be manufactured from common coal, there were certain advantages in gas transmission which were entirely lacking in the transmission of energy in any other form. The loss of power which took place in a gas main might be roughly stated to vary as the square of the velocity of the fluid within it; and since the density of gas was small as compared with water, the actual co-efficient of friction was very low. To pass a given amount of power, in the shape of gas, through a main, either the velocity must be increased or the gas must be transmitted under pressures very much in excess of those used in a main conveying lighting gas.

Having described briefly the methods of producing coal gas, water gas, and Dowson and Mond producer gas, Professor Burstall went on to say that in order to obtain all the advantages of the transmission of power by gas, the producer station should be placed as near as possible to the field whence the coal was obtained, so as to reduce the cost of transmission of the raw material. The size of the plant should, of course, be large—not less than 5,000, but preferably from 20,000 to 50,000-horse power. In most cases there would not exist in the immediate neighborhood any large demand either for power or gas for heating. It was necessary, therefore, either to transform the gas into electrical energy on the spot, or else transmit the gas itself in pipes. A great advantage attending the transmission of gas was due to the fact that it might be reasonably expected to obtain a very much better load factor than was the case with electricity, because not only was the demand for heating larger than that for power and lighting, but, in general, it was a much more even load. It was fair to assume that of the total gas produced 60 per cent. would be used for heating purposes, and that the load factor for this portion would be 50 per cent.—that was to say, 30 per cent. would be the load factor of the whole plant for heating purposes. The remainder of the gas would be used for power, for which he estimated a load factor of 25 per cent. as favorable. This gave a total load factor of (say) 38 per cent. for the gas producing station. The gas would be distributed at pressures suitable for the length of transmission. These were given in a table, which showed that, with only a moderate velocity of 30 feet per second, a transmission length of nearly 80 miles could be reached with a pressure of 44 pounds per square inch and an efficiency of nearly 90 per cent. A main 4 feet in diameter would, under these conditions, transmit nearly 57,000-horse power—a figure which he ventured to say was quite as high as could be obtained by any electrical distribution. The gas would be led to sub-stations, from which the mains would distribute it to customers at low pressure. At these stations there would be placed the large gas engines for the production of two or three-phase current at a high pressure of from 5,000 to 15,000 volts, according to the size of the locality covered. The current required for lighting and traction would be obtained by converters located at suitable spots. The manufacturer requiring power could either be supplied with a polyphase current at reduced voltage, or he could use the continuous current. The use of large gas engines for the probuction of polyphase current seemed to be viewed with some suspicion. It might, however, be taken as quite certain that gas engines of 1,000-horse power could be obtained, which would work with such regularity as to enable the alternators to be run in parallel. He knew of one large station of 10,000-horse power which was about to be erected with gas driven alternators of 1,500-horse power each; and he saw no reason to doubt the fact that in the course of a few years it would be possible to obtain gas engines of from 3,000 to 4,000-horse power as readily as those of 700-horse could now be procured. The greatest objection to the transmission of gas under pressure appeared to be a doubt existing as to whether a sufficiently gas tight joint could be obtained. This was, to say the least, very curious, considering that all engineers were familiar with the hydraulic joint, which remained perfectly tight under pressures of from 700 to 1,500 pounds per square inch. The ordinary joint used in a gas pipe was, of course, wholly out of the question. The joint would probably be a faced one, and the lengths of pipe would be bolted together with a ring of some flexible material placed between. A very similar joint to this had been in existence on the Paris air mains for years; and careful experiment had shown that the leak under a pressure of 100 pounds to the square inch need not exceed 4 per cent. per mile, and this with a main in which there were many connections to customers. In the pipe line he had indicated, there would be very few branches and valves; and he was certainly of opinion that modern engineering was quite capable of making a joint in which the leak should not exceed $\frac{1}{10}$th of 1 per cent. per mile. The cost of the main was what he would not like at present to speak about in too confident a manner, as so much depended upon the locality in which the pipes were laid; but there was no reason to suppose that it would be as much as for electric mains laid underground, and transmitting the same amount of power. If it were possible to utilize the existing gas mains, of course the economy would be very considerable.

Professor Burstall concluded by pointing out that an important matter arising out of the general use of gaseous fuel was that a complete solution of the smoke problem would be furnished. Those who lived in smoky cities probably hardly realized the immense sums which were spent for cleaning, due entirely to the use of coal in its solid form. Could this money be saved, there would be a large increase in the national wealth, and—what he ventured to think was of more importance—a considerable increase in the national *physique*. As year by year the population of the country increased, so did the smoke problem become more and more important. The use of gaseous fuel would save from one-third to one-half of the total coal, and would add in no little degree to the comfort and happiness of every individual.

At the close of his paper, Professor Burstall explained a large table which had been prepared to show the efficiency of a scheme for the transmission of gas through a main 4 feet in diameter, taking 70 cubic feet of gas per brake horse power hour. With initial velocities of 20, 30 and 40 feet per second, and an initial pressure of 15 pounds (absolute) per square inch, the brake horse powers delivered by the main worked out to 13,130, 19,200 and 26,260; the length of transmission being 7½, 3½ and 2 miles; while the efficiency of transmission worked out to 99.7 per cent. On selecting some of the other figures given, it could be seen that 28,300 brake horse power could be delivered 8.6 miles with 99.2 per cent. efficiency with an initial pressure of 1.1 atmospheres—the exhaust in all cases being at atmospheric pressure. With 1¼ atmospheres, and a velocity of 40 feet per second, 38,750-horse power could be sent 33 miles (or with a velocity of 20 feet per second 19,300-brake horse power could be sent 133 miles) at an efficiency of 96.2 per cent. It was clear, however, from the curves shown, that it would not pay to compress the gas much above 1¼ to 2 atmospheres, for at 4 atmospheres, with the same length of main, although 103,200-brake horse power could be transmitted 46 miles with a velocity of 40 feet per second (or about one-half the power, at a velocity of 20 feet per second, to a distance of 182 miles), ye

the efficiency of transmission came as low as 87 per cent. With 7 atmospheres it fell to 81.5 per cent., though with a 20-foot velocity upwards of 90,000-brake horse power could be transmitted 196 miles, or almost twice the power about one-fourth of the distance. In all these calculations, the author assumed that the line would be gas-tight, and he neglected leaks of every description.

In the course of the discussion upon the paper,

The Chairman said Prof. Burstall had not told them at what figure he proposed to supply the Mond gas; but it had been stated that the price was proposed to be 4 cents per 1,000 cubic feet. Worked out on the basis that every cubic foot contained 150 thermal units, and that a ton of ordinary engine slack contained 11,000 to 12,000, it would be found that, in order to get the same heat from the Mond gas that would be obtained from the combustion of coal, they would have to pay at the rate of $9 a ton for the slack. Therefore the use of Mond gas would not effect a saving in the cost of fuel, unless the quantity necessary for carrying on operations could be very much reduced.

Sir Oliver Lodge asked if it was hopeless to produce more ordinary coal gas, of much greater heating power than Mond gas, for the purpose of long distance transmission. Producer gas was much cheaper than coal gas, but it had only, he believed, one-third of its heating power, and, therefore, it was very bulky for sending a long way. If it had to be consumed on the spot, or if it was burnt in the factory producing it, well and good; but if it had to be conveyed 133 miles, he should say the interest on the cost of the mains would swallow up the difference in price. Moreover, the coke yielded in its manufacture was almost a waste product. He had long thought the proper method of supplying a town with heat was not to carry coal to it in order to dirty the air and have the ashes to remove, not to choke up the railway with coal trucks, but to convey that which travelled much more easily—namely, some form of fluid—electricity or gas. They should convert the coal into gas at the pit's mouth, and then let it flow over any reasonable distance, and by means of a pumping station start it thence again on its journey, instead of trying too much initial pressure, which it was obvious was not economical.

Mr. Bell said it seemed to him that it would be very much more expensive to make a 48-inch main that would be tight than such a main as the author had spoken of. As to large gas engines, no doubt in a comparatively short time 2,000 and 3,000-horse power engines would be as common as were steam engines of these powers now. Deductions from Professor Burstall's figures showed a leakage of producer gas over a distance of 133 miles of rather more than 30 per cent.; and he (Mr. Bell) was not quite sure that with such a leakage the city atmosphere would not be worse than it now was with smoke. The carrying of pipes through land which had been undermined also appeared to him to be a very great difficulty.

Professor Threlfall, as one who had made many hundreds of millions of cubic feet of producer gas, pointed out how difficult it was to say what the cost of manufacture would be in any particular case. The figures quoted by Professor Burstall from Mr. Humphrey would only apply to the conditions of the Midlands in a very remote and general way.

Mr. A. M. Taylor, contending for the superior advantages of electric transmission, said the whole thing hung very much on the vital question of the load factor.

Mr. C. A. Smith, referring to the future of large gas engines, remarked that it was rather strange that the exhaustive trials which had taken place had not given a greater impetus to the production of such engines. However, he had been in communication with some of the companies interested in their manufacture, and had heard from the English representatives of one of them that they would actually guarantee a 5,000-horse power horizontal engine, 4-cylinder tandem, with two cranks, to run with alternators in parallel with a 40-ton fly wheel. This, however, was a Continental make, and the Company concerned had not any engines actually running yet. With regard to the transmission of gas, Sir Oliver Lodge had arrived at the conclusion that it was best to use moderate velocities; but he (Mr. Smith) had formed quite a contrary opinion. He pointed out to Sir Oliver that the efficiency of transmission was the same at velocities of 20, 30 and 40 feet per second, though, of course, the length of transmission was different. He also called attention to the tremendous increase in the brake horse power transmitted by the 4-foot main with the high velocities. He ventured to say that, for transmissions over 20 miles, it would pay to use velocities as high as 80 feet per second, because the extra cost of compressors would be less than the additional interest on the main. He had been considering two alternative schemes—viz., the generating of electricity by means of a producer gas station on the coal field, and transmitting it to sub-stations, and the transmitting of Mond gas to sub-stations to be used for gas engines located there. Given the same load factor in each case, he greatly favored the former scheme, because it enabled good use to be made of the heat of the exhaust gases from the engines, and also because of the greater economy of large gas engines. But if a considerable part of the producer gas was to be used for heating purposes, the conditions were altered; and if the producer gas obtained a load factor of 40 per cent., while electricity had only 20 per cent., it was easy to see that the former would have an advantage.

Mr. D. K. Morris thought the cost of a pipe line for the transmission of gas would be very great as compared with the lowest price of an electric line. It seemed to him that gas power transmission would be rather a suitable thing in the case of corporations who were able to raise money at a low rate, or, generally speaking, when the quantity of gas required to be transmitted was on a fairly large scale, and when it was also possible not to regard interest on capital too much. Though Professor Burstall had not raised the question of cost, he (Mr. Morris) felt they must bring this immediately before themselves to see how they stood.

Professor Burstall, in reply, said he knew quite well that the commercial aspect of the question would be raised, and he was very glad indeed to think he himself had kept clear of it. The Chairman had put his finger on a very important point with regard to the price of gas being equivalent to that of slack at a very high cost. Of course, comparing the amount of heat derivable in the form of lighting gas with coal, it certainly was; but it paid to use a small engine and lighting gas rather than a large boiler and coal. They could afford to pay a very high figure for heat if supplied in a convenient form. He should say the price of producer gas would be considerably less than the amount quoted by the Chairman, if supplied in bulk. Sir Oliver Lodge had in a very happy way raised a question which was constantly being brought forward as to supplying a gas of a higher calorific power. Everybody said: Why make producer gas when more than half of it is incombustible? Of course, gas could be made from coal very much more cheaply than the existing lighting gas, and so could water gas; but in both cases the cost was too great for people to be able to afford to use it in competition with other means of transmission. He had recently to do with an immense transmission extending to 300 miles across what was practically a desert, and the question was whether overhead wires or a main would be best. The main carried it off. What everybody seemed to have forgotten was that the gas main had a load factor; but whether it was so in the case of the electric main they did not know, and money could be spent on a main when there was a load factor of 40 per cent. As to coke, it was a very inefficient thing from a gas point of view; and if wanted for special purposes, it must be made. As to leakage, in America the pipe lines ran for hundreds of miles, and there was no trouble whatever about the leaks. It was not a serious matter to have a leak in a producer gas main in an open country; and the mains would run over such country and not in towns at this pressure. The question of the sinking of strata due to coal being taken away was, of course, very serious; but this also was capable of solution. It would only be a matter of putting in rivetted steel mains, and making proper arrangements for holding them up at intervals. Large gas engines, which had been alluded to by Mr. Smith, had not come into use to anything like the extent that was anticipated at one time, and the reason was that unfortunately in this country the large gas driven central station had been a failure. But he did not think that this would occur again. At any rate, there were plenty of engines of immense size on the Continent. Dr. Morris's remarks with regard to the cost of the line were very interesting; but the matter did not really enter into the paper.

A vote of thanks was accorded to Professor Burstall.

A Statement from the Trustees of the Gas Educational Fund.

TRUSTEES GAS EDUCATIONAL FUND,
58 WILLIAM STREET, N.Y. CITY, May 21, 1903.

In 1898 a committee appointed by the American Gas Light Association secured subscriptions, amounting to $3,193 annually for a period of five years, to be devoted to aiding and directing the efforts of the many partially educated employees of gas companies who are striving to fit themselves to occupy positions of greater responsibility with such companies. The administration of this fund was intrusted to a Board of Trustees appointed by the Association. Further subscriptions were obtained by these Trustees, the income for the current year being $4,220. The period covered by the majority of these subscriptions expires October 1st, 1903,

and the last installments on them have been paid in. Feeling that the work carried on under their direction is of too much importance to be discontinued, the undersigned members of the Board of Trustees, Gas Educational Fund, request the renewal of your subscription for another term of five years, and submit, as a full and sufficient reason for such a renewal, the following statement of the results accomplished since the establishment of the fund.

The educational work has been carried on by means of a Correspondence Class under the direction of the Secretary. A copy of the rules governing eligibility for, admission to and continuance of membership in the Class is inclosed for your information. The maximum membership in this Class (168) was reached January 1st, 1903, and on March 25th, 1903, the roll contained the names of 155 members, 13 having completed the course since January 1st. The average number at work in the Class during the 4½ years has been slightly over 100. Three sections of the Class have completed the course of 3 years. In addition to those who completed the full course, 26 members of the Second Section finished two years' work before being obliged, by various causes, to drop out of the Class, and 20 members of the Fourth Section to enter are now beginning their third year.

Education by correspondence is not, of course, as complete and satisfactory as education in which instructor and instructed can come in personal contact, nor can a student whose only time for study is such as he can secure in the leisure left him after a day's work, cover as much ground in a year as can be covered by a student at college whose first business is study. But in this case a "Correspondence Class" is the only possible means of reaching the men it is desired to benefit, and it is gratifying to be able to state that work in the Class has proved itself of great value to the members in enabling them to fit themselves, either for the promotion that has come in many cases, or for the better filling of the positions originally held. And from this fitting of their employees to perform their duties in a more efficient manner the gas companies themselves must have derived benefit. We believe that the work of the Class has returned directly to the gas companies subscribing to the fund more than the amount of their subscriptions.

In addition to the Class work a card index of the principal articles published in the American Gas Light Journal, *Progressive Age* and the *Journal of Gas Lighting* is kept up to date. This index extends back to 1894. It is open to subscribers, and its value to any person wishing to read up on any subject connected with the gas industry will be readily appreciated. Subscribers living at a distance from New York can still avail themselves of this index by writing for lists of reference upon subjects in which they are particularly interested.

The Trustees have personal knowledge of the good done by this work to many members of the Class, and letters from these beneficiaries bear earnest testimony to the gratitude of men whose only opportunity for obtaining technical knowledge of their business comes through your generosity.

As the members of the Class have benefited by the instruction given, through increased knowledge of their business, and in some degree through the general elevation of character inseparable from such work as they do in the Class, they necessarily improve in the manner of the performance of their daily duties. The continuation of this Class is, therefore, important alike to the men who receive its instruction, and to you, whose work will be better done because of it. We, therefore, feel fully justified in asking for and expecting at least a renewal of your former subscription, and would suggest that it be increased by an amount proportional to the amount by which your business, and consequently your interest in the matter, has increased in the past five years. As you have been informed by the annual reports issued, the unexpended balance is put each year into a permanent fund, which it is hoped will, in time, grow large enough to yield sufficient income to defray the cost of the work. It is, therefore, very desirable that the amount subscribed shall be larger than this cost, which with the increased size of the Class will be about $5,000 per year.

Yours truly, Walton Clark, Chairman,
Eugene Vanderpool, Treasurer,
W. F. Douthirt,
Alex. C. Humphreys,
W. R. Beal,
Alten S. Miller.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

The business of the leading gas works' tray manufacturer of this country, Mr. John Cabot, has increased to such an extent that his partners and himself have found it necessary to have more room and better manufacturing facilities. To complete their purpose they have decided to remove their shops from New York to Hoboken, N. J., in which city they have purchased a plot of 9 full lots, at Adams and Fifteenth streets, whereon they are completing a brick factory, to be equipped with machinery of modern type. The new plant will be large enough to enable the concern to do at least four times the work that was done in the New York shops.

A correspondent forwards the following from San Francisco, Cal., under recent date: "In these gigantic struggles of capital it is generally the weak stockholders and the public that suffer. It is, as it were, only yesterday since the market for San Francisco Gas and Electric went up with a bound on the presumption of a pool being successfully organized that would take the stock up to $90. But now it is like the baseless fabric of a vision. Gas stock has been tumbling. From sales at $57.50 the stock has gone down to $50 offered, and no dividends for over a year and no prospect of any. Crockett got a good many black eyes before the inauguration of the new regime, but he is revenged, and many, in their anguish, are inclined to cry out, 'Oh! for one hour of Crockett.'"

Mr. A. M. Duncan has been appointed General Manager of the American Gas Engine Company, vice Mr. J. W. Russell, resigned. Mr. Duncan's headquarters are in Green Bay, Wis.

At the annual meeting of the shareholders in the United Gas, Electric Light and Fuel Company, of Sandy Hill, N. Y., the following officers were chosen: Directors, Jno. L. Wentz, W. C. Hendrickson, A. R. Wing, A. E. De Forest, Geo. Sherrill, Jas. D. Sherrill, M. C. Allen, W. A. Huppuck and J. P. Monty; President, W. C. Hendrickson; Vice-President, J. D. Sherrill; Secretary, J. P. Monty; Treasurer, John L. Wentz; General Manager, Wm. L. Clarke.

The Washington (D. C.) *Post* of the 13th inst., had this to say: "The Directors of the Washington Gas Light Company at a meeting yesterday afternoon decided to distribute among the stockholders an extra dividend of $20 a share in the form of 6 per cent. certificates of indebtedness to the amount of $2,000,000 The certificates are to run from 5 to 20 years, at the option of the Company. The stockholders of the Company will meet on Thursday, May 21, to ratify the action of the Directors. The distribution will be made within the next 30 days. It is understood that the books of the Company will be closed at the end of the present mouth. There are 130,000 shares of the capital stock of the Company, of a par value of $20, making the total capitalization of the Company $2,600,000. This amount will be duplicated in the new issue of certificates of indebtedness; a dividend of 100 per cent. For each 5 shares of stock owned a stockholder will receive a $100 certificate. There is at present outstanding $600,000 of certificates of the Company. This, with the $5,200,000 of capital stock and new certificates will make the total capitalization of the Company $5,800,000. The first intention of the chief directors of the Company was to make the extra dividend a larger one. In the past 3 days the change of plan has been decided on for reasons which the Directors do not announce. It is to be noted, however, that there has been no distribution of cash announced, and that the large surplus of the Company is still intact and an asset belonging really to the stockholders, whether it is paid out or not. Another factor to be taken into consideration in computing the value of the dividend and of the stock is the high rate of interest to be paid on the new certificates. The stockholders will receive $156,000 a year interest on the new issue. There is much figuring among the experts over the probable market price of the certificates. Opinions differ widely. Some brokers do not expect them to sell much, if any, above 109 because of the option held by the Company to pay them off in 5 years. The market value of bonds of all kinds, including government issues, decreases as the life of the bonds grows shorter. On the other hand, if the bonds are allowed to run 20 years, their value as an investment would be computed to be anywhere between 130 and 150. It seemed to be an impression quite generally held yesterday afternoon that the market price will be around 120 in the near future. Gas stock advanced to 95 two weeks ago, when it was expected that the extra dividend would be larger. It has been declining steadily in the past week or more, and yesterday sold at 88 and a fraction. This decline is supposed to measure, in part at least, the opinion of insiders as to the lesser value of the dividend, Much interest is felt in the course that the stock will take to-day."

Mr. Grorge H. Brown, Superintendent of the Morristown (N.J.) Gas Light Company, writing from Morristown under date of the 19th inst., says: Referring to the communication of Mr. B. F. Bullock, as published in the Journal dated the 4th inst., on the matter of meter connections, I would make the suggestion that one iron and one lead connection makes the best all-round connection. That is and has been our practice here for years.

Mr. M. E. Malone has resigned the post of General Superintendent of the Madison (Wis.) Gas and Electric Company to accept the Superintendency of the gas department of the Denver (Col.) Gas and Electric Company.

THE gas rate at Bristol, Pa., has been reduced to $1.25 per 1,000 cubic feet, a concession of 35 cents per 1,000.

MESSRS. W. W. MERCER and H. T. Ingersoll have applied to the authorities of Hancock, Mich., for the right to operate there a gas works.

A CORRESPONDENT forwards the following: "On the 12th inst. the promoters of the Hammonton and Egg Harbor City Gas Company, of Hammonton, N. J., completed its organization. The officers named were: Directors, H. E. Woodman, M. L. Jackson, T. C. Elvins, G. M. Crowell, L. Monfort, W. H. Burgess, John A. Hoyle, H. McD. Little, J. C. Johnson, C. E. Starr, A. M. Worstall and Wm. S. Graham; President, H. E. Woodman; Vice-President, M. L. Jackson; Secretary and Treasurer, Joseph L. O'Donnell.

THE Connecticut Legislature has assented to the petition of the Windsor Locks Electric Lighting Company to permit it to manufacture and distribute gas in Windsor Locks.

MR. A. E. HAY, of Elyria, O., has been appointed Manager of the Oberlin (O.) Gas and Electric Light Company.

GOVERNOR ODELL has signed the amendment to the penal code of New York State which makes it a criminal act for a junk dealer to purchase material stolen from a railroad, gas or electric light, telephone or telegraph company.

MAYOR CHAPIN, of Holyoke, Mass., has signed the order fixing the salary of the Manager of the Municipal Light Department at $4,000 per annum. There is very little doubt that the present Acting Manager (Mr. W. H. Snow) will be appointed Manager.

THE General Assembly of Connecticut has sanctioned the resolution amending the charter of the New London Gas and Electric Company, permitting it to issue bonds to the amount of $750,000 for the purpose of retiring its present outstanding bonds, debentures and floating indebtedness. The Company is also empowered to "maintain and operate an electric or street railway."

MESSRS. R. B. HUSSEY, JNO. S. Grouard, Edward A. Lawrence, Arthur H. Cook, A. G. Brock and R. B. Coffin have petitioned the authorities for the right to supply gas to the residents of Siasconset, Mass.

THE Directors of the Massachusetts Gas Companies have declared a semi-annual dividend of 2 per cent. on the preferred stock, payable the 1st prox. This is the first regular dividend declared on these shares.

MR JOHN D. THOMAS, of Trenton, N. J., has applied to the authorities of Carterville, Md., for the right to there operate a gas works for a period of 30 years. He agrees to charge not to exceed $1.50 per 1,000 cubic feet, and further promises to have the plant in operation within a twelvemonth after the franchise is signed.

AT the annual meeting of the Bristol (Pa.) Gas Company, which concern is now controlled by the South Jersey Gas, Electric and Traction Company, the following Directors were elected: John L. Kuser, Jas. Buchanan, M. R. Margerum, Thomas Scott and R. V. Kuser.

MR. C. D. OLIGER and associates will build a gas works at Cleburne, Tex. It is estimated that the expenditure in connection therewith will be not less than $50,000.

THE Connecticut Railway and Lighting Company is arranging for the construction of a gas plant in Greenwich, Conn.

THE proprietors of the Springfield (Mass.) Gas Light Company have declared a regular quarterly dividend of 2½ per cent., and an extra dividend of 2 per cent.

THE New England Insurance Exchange is about to adopt new rules affecting acetylene gas plants that are maintained within buildings, and at its next meeting the recommendation of the Executive Committee to enforce an extra charge for risks dependent upon the use of such plants will be adopted. It is proposed to add 25 cents per $100 of insurance on buildings in which acetylene lighting machines are located.

CAPTAIN DAVID BOYNTON, formerly Manager of the Chicopee (Mass.) Gas Light Company, died in Lexington, Mass., the morning of the 12th inst. He was in his 65th year.

THE plant and franchises of the Washington (Ind.) Gas Company have been sold to Chicago capitalists, who will assume possession thereof July 1st.

MR. GEORGE B. ELLIS, of Redlands, Cal., has been granted a franchise for the operation of a gas plant in Colton, Cal., for a period of 25 years. The selling rate fixed upon is $1.50 per 1,000.

THE new gas plant in Seymour, Ind., is in satisfactory operation, and the people are greatly pleased over the gas service that is at their command.

THE proprietors of the Merced Falls (Cal.) Gas and Electric Company have notified the residents that until further announcement is made, the selling rates shall be: For a monthly consumption under 2,000 cubic feet, $2 per 1,000; over 2,000 cubic feet, $1.75.

Engineering Record notes that the new shops of the Electric Light Company, Lecourbe street, Paris, France, cover an approximately rectangular area about 340 feet long and 131 feet wide, and have self supporting walls and a steel roof carried partly on the walls and partly by six longitudinal rows of columns. The general arrangement and structural features closely resemble those usually adopted for similar structures recently built in this country. There are two main aisles about 33 and 39 feet wide, each having a narrower aisle on each side, the adjacent side aisles 13 feet wide uniting on a center line of columns in the axis of the shop. The outer side aisles are respectively 13 and 30 feet wide, and all of them differ from ordinary American practice in having flat horizontal roofs instead of shed roofs. The main aisles have riveted triangular trusses with horizontal bottom chords, vertical members and single diagonals, and have glazed clere-stories about 12 feet high above the roofs of the side aisles. The shops have two stories throughout, the upper one being carried in the main aisles by deep transverse plate girders and in the side aisles by transverse box girders. The columns all have I-shaped cross sections with solid plate webs up to the second floor and lattice webs above. In each aisle, except the two center ones, there are traveling girder cranes, which in the main aisles have capacities of 10 and 15 tons each, and have their track girders supported across the tops of, and are knee-braced to, independent columns adjacent to the roof columns. These girders have in some cases double and in other cases single webs and all support on their reinforced upper flanges solid rectangular steel rails. In the side aisles the track girders are in the lower stories and are supported on brackets from the wall columns, except in the 20-foot aisle, where the outer wall has no columns, and special buttresses are provided in it for the girders. The arrangement of skylights in the roofs of the main aisles is peculiar, in that the center of the roof is covered with a tile surface and the glazing extends from the eaves one-third of the distance to the ridge. The building is braced longitudinally by the track girders for the traveling cranes and by the second story floor girders, which have rectangular box sections in the outer and center lines of columns and are ordinary plate girders elsewhere. Longitudinal struts at the eaves are braced to the girders below them with zigzag angles, thus approximately forming deep lattice girders in the upper parts of the walls. Bents are 26½ feet apart, and each panel of the roof is braced with two zigzag angles each side of the ridge. The roof trusses and purlins, the box girders and the track girders for the 10 and 15-ton cranes are of steel, calculated for a maximum working stress of 16,300 pounds per square inch. The columns and their beams and girders are of iron calculated for a maximum working stress of 6,170 pounds per square inch. The assumed loads per square foot are 100 pounds and 160 pounds for the galleries, 60 pounds for the flat slag roofs, 27 pounds for the tiled pitched roofs and 16 pounds for the glazed skylights. The columns and track girders for the crane service are calculated for the heaviest loading, which gives reactions of about 26,450 pounds and 14,325 pounds for each end of each of the two largest cranes. The roof columns have 11-inch webs and 8½-inch flange plates, and have their bases 20 inches below the shop floor. The wall columns, with maximum loads of 25 tons each, have 30×18½-inch base plates seated on 33×50-inch stone pedestals on concrete piers 70.7 inches in diameter. This gives maximum pressures of about 374 pounds per square inch on the stone, 128 pounds per square inch on the concrete, and 8,200 pounds per square foot on the earth.

The Market for Gas Securities.

Odd ways are those that marked the track of speculation on the Exchange last week. The general trading was done at declining prices for the most part, without any particularly good reasons in sight for the weakness shown. Consolidated sold down to 202, and eventually got back to 204½, which was the last sale recorded to-day (Friday.) Unless the general situation grows much worse than it is to-day, Consolidated should make a record mark between now and September 1st.

Brooklyn Union is seemingly dead, so far as trading goes, but it would take very little revivifying to send it up to 50 points. Signs are in evidence that the amalgamation interviews are soon to be renewed. Bay State is one-quarter bid. Think of it, ye who have some of it at 30 and over. Baltimore is quoted at 68¾ bid, ex-dividend. Washington (D. C.) gas is a trifle weaker. Some mention of the scrip dividend on the shares is made in our item columns for this week. Good gas bonds (and most of them may be so classed) are in brisk demand.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 Wall Street, New York City.

May 25.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	204	204½
Central Union, Bonds, 5's	3,000,000	1,000	109	111
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	300	310
Municipal Bonds	750,000	..	..	
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	108⅛	109
Northern Union, Bonds, 5's.	1,250,000	1,000	104	107
New York and East River				
Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000		109	111
Standard	5,000,000	100	131	..
Preferred	5,000,000	100	132½	..
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115½	118
Yonkers	299,650	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	208	220
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	¾	⅞
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	7	10
" " Bonds, 5's	5,250,000	1,000	73	76
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central, San Francisco	900,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co..	29,500,000	100	98½	99
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89¼
Preferred	3,026,500	100	107½	109
Consumers, Jersey City Bonds	600,000	1,000	100	102
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	68¾	69
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	85	87
Consolidated G. & E. Co.'s.				
Little Falls, N.Y.	90,000	100		100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,825,500	50	..	89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	352,000	1,000	77	79
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	70	80
" Bonds, 6's	2,650,000	..	102	104
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	97	105
Preferred	2,500,000	100	100	110
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind	1,000,000	100		60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	130	140
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	184¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	300	325
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	.
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	100⅛	100¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	51¼	52
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	95	96¼
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	113½	115
General Mortgage, 5's	2,465,000	1,000	92	93

Advertisers' Index.

GAS ENGINEERS. Page

A. E. Boardman, Brevard, N. C. 832
Baxter & Young, Detroit, Mich. 832
David Leavitt Hough, New York City. 832
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 824
Frank D. Moses, Trenton, N. J. 819
Fred. Bredel Co., Milwaukee, Wis. 820
Geo. R. Rowland, New York City. 832
Humphreys & Glasgow, New York City. 833
Kerr Murray Mfg. Co., Fort Wayne, Ind. 832
The Gas Machinery Co., Cleveland, O. 819
The Jeffrey Manufacturing Co., Columbus, O. 829
The Western Gas Construction Co., Fort Wayne, Ind. 800
United Gas Improvement Co., Philadelphia, Pa. 837
Wm. Henry White, New York City. 835

GAS WORKS APPARATUS AND CONSTRUCTION.

A. E. Boardman, Brevard, N. C. 832
Bartlett, Hayward & Co., Baltimore, Md. 833
Baxter & Young, Detroit, Mich. 832
Christopher Cunningham, Brooklyn, N.Y. 829
Connelly Iron Sponge and Governor Co., New York City 784
Continental Iron Works, Brooklyn, N. Y. 834
Davis and Farnum Mfg. Co., Waltham, Mass. 832
Delly & Fowler, Philadelphia, Pa. 836
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 824
Frank D. Moses, Trenton, N. J. 819
Fred. Bredel Co., Milwaukee, Wis. 820
G. Shepard Page's Sons, New York City. 832
Humphreys & Glasgow, New York City. 833
Isbell-Porter Company, New York City. 834
Kerr Murray Mfg. Co., Fort Wayne, Ind. 832
Lloyd Construction Co., Detroit, Mich. 832
Logan Iron Works, Brooklyn, N. Y. 836
Quintard Iron Works, New York City. 833
R. D. Wood & Co., Philadelphia, Pa. 834
Riter-Conley Mfg. Co., Pittsburg, Pa. 833
Stacey Mfg. Co., Cincinnati, O. 835
The Connersville Blower Company, Connersville, Ind. 837
The Gas Machinery Co., Cleveland, O. 819
The Jeffrey Manufacturing Co., Columbus, O. 829
The Western Gas Construction Co., Fort Wayne, Ind. 800
United Gas Improvement Co., Philadelphia, Pa. 827

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md. 83
B. E. Chollar, St. Louis, Mo. 832
Economical Gas Apparatus Construct'n Co, Toronto, Ont. 834
Humphreys & Glasgow, New York City. 833
The Gas Machinery Co., Cleveland, O. 819
The Western Gas Construction Co., Fort Wayne, Ind. 800
United Gas Improvement Co., Philadelphia, Pa. 827

SCRUBBERS AND CONDENSERS.

Continental Iron Works, Brooklyn, N.Y. 834
Kerr Murray Mfg. Co., Fort Wayne, Ind. 832
Logan Iron Works, Brooklyn, N. Y. 836
R. D. Wood & Co., Philadelphia, Pa. 834
Riter-Conley Mfg. Co., Pittsburg, Pa. 833
The Gas Machinery Co., Cleveland, O. 819
The Western Gas Construction Co., Fort Wayne, Ind. 800

PRODUCER POWER PLANTS.

R. D. Wood & Co., Philadelphia, Pa. 834

TAR AND CARBONIC ACID EXTRACTOR.

The Gas Machinery Co., Cleveland, O. 819
The Western Gas Construction Co., Fort Wayne, Ind. 800

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich. 816
The Gas Machinery Co., Cleveland, O. 819
The Western Gas Construction Co., Fort Wayne, Ind. 800

GAS METERS.

American Meter Co., New York and Philadelphia. 839
Detroit Meter Company, Detroit, Mich. 799
D. McDonald & Co., Albany, N.Y. 837
Helme & McIlhenny, Philadelphia, Pa. 839
John J. Griffin & Co., Philadelphia, Pa. 840
Keystone Meter Co., Royersford, Pa. 838
Maryland Meter and Mfg. Co., Baltimore, Md. 838
Metric Metal Co., Erie, Pa. 839
Nathaniel Tufts Meter Co., Boston, Mass. 838

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia. 839
D. McDonald & Co., Albany, N. Y. 837
Helme & McIlhenny, Philadelphia, Pa. 839
John J. Griffin & Co., Philadelphia, Pa. 840
Keystone Meter Co., Royersford, Pa. 838
Nathaniel Tufts Meter Co., Boston, Mass. 838

PREPAYMENT METER ATTACHMENTS.

Reeves Mfg. Co., New Haven, Conn. 820

GAS AND WATER PIPES.

Charles Millar & Son Co., Utica, N. Y. 824
Christopher Cunningham, Brooklyn, N.Y. 829
Donaldson Iron Co., Emaus, Pa. 824
M. J. Drummond & Co., New York City. 824
R. D. Wood & Co., Philadelphia, Pa. 834
Warren Foundry and Machine Co., New York City. 824

SPECIALTIES FOR OIL AND PIPE LINES.

S. R. Dresser, Bradford, Pa. 821

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N.Y. City. 824

GAS TAPPING MACHINES.

George Light, Dayton, O. 824
H. Mueller Manufacturing Company, Decatur, Ills. 821

GAS COALS.

Berwind-White Coal Mining Co., New York and Phila. 830
Perkins & Co., New York City. 830
Westmoreland Coal Co., Philadelphia, Pa. 831

CANNEL COALS.

Perkins & Co., New York City. 830

STOKING MACHINERY.

G. A. Bronder, New York City. 816

AUTOMATIC WEIGHING MACHINERY.

Richardson Scale Co., New York City. 820

CONVEYORS.

C. W. Hunt Company, New York City. 821
G. A. Bronder, New York City. 816
Kerr Murray Mfg. Co., Fort Wayne, Ind. 832
The Gas Machinery Co., Cleveland, O. 819
The Jeffrey Manufacturing Co., Columbus, O. 829
The Link-Belt Machinery Co., Chicago, Ills. 831
The Western Gas Construction Co., Fort Wayne, Ind. 800

CHARGING BARROWS & COAL WAGONS.

Kerr Murray Mfg. Co., Fort Wayne, Ind. 832

GAS ENRICHERS.

Gulf Refining Co., Pittsburg, Pa. 830
Standard Oil Co., New York City. 831
The Sun Oil Co., Pittsburg, Pa. 831

COKE CRUSHERS.

C. M. Keller, Columbus, Ind. 831
The Jeffrey Manufacturing Co., Columbus, O. 829

STEAM BLOWER FOR BURNING BREEZE.

The Connersville Blower Company, Connersville, Ind. 837

ECONOMIZERS.

Green Fuel Economizer Co., Matteawan, N.Y. 822

GAS GAUGES.

The Bristol Co., Waterbury, Conn. 829

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 783
Isbell-Porter Co., New York City 834
R. D. Wood & Co., Philadelphia, Pa. 834

CEMENTS.

C. L. Gerould, Galesburg, Ills. 828

RETORTS AND FIREBRICKS.

Adam Weber Sons, New York City 828
Baltimore Retort and Firebrick Co., Baltimore, Md. 823
Brooklyn Firebrick Works, Brooklyn, N. Y. 828
Henry Maurer & Son, New York City 826
James Gardner, Jr., Co., Pittsburg, Pa. 828
J. H. Gautier & Co., Jersey City, N. J. 828
Laclede Firebrick Mfg. Co., St. Louis, Mo. 828
Missouri Firebrick Co., St. Louis, Mo. 823
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 817
The Kreischer Brick Mfg. Co., New York City 828

INCLINED RETORTS.

Adam Weber Sons (Graham, Morton [England] System) 818
Connelly Iron Sponge & Gov. Co. (Drake's [Eng.] System) 783

VERTICAL S'S.

Adam Weber Sons (Oscar B. Weber's Construction) 828
Connelly Iron Sponge & Gov. Co. (Drake's [Eng.] System) 783

REGENERATIVE FURNACES.

Adam Weber Sons, New York City 828
Bartlett, Hayward & Co., Baltimore, Md. 833
Fred. Bredel Co., Milwaukee, Wis. 820
J. H. Gautier & Co., Jersey City, N.J. 828
Laclede Firebrick Mfg. Co., St. Louis, Mo. 828
Missouri Firebrick Co., St. Louis, Mo. 828
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 817

SELF-SEALING MOUTHPIECE DOORS.

Continental Iron Works, Brooklyn, N.Y. 834
Isbell-Porter Co., New York City 834
Kerr Murray Mfg. Co., Fort Wayne, Ind. 832
Logan Iron Works, Brooklyn, N.Y. 836
R. D. Wood & Co., Philadelphia, Pa. 834
The Gas Machinery Co., Cleveland, O. 819
The Western Gas Construction Co., Fort Wayne, Ind. 800

CHIMNEY CONSTRUCTION.

Adam Weber Sons, New York City 828

INCANDESCENT GAS LAMPS.

Ball Check Light Co., New York City 819
Detroit Arc Gas Light Co., Detroit, Mich. 816
D. M. Steward Mfg. Co., Chattanooga, Tenn. 820
Welsbach Company, Gloucester, N. J. 826

BURNERS.

C. A. Gefrorer, Philadelphia, Pa. 820
D. M. Steward Mfg. Co., Chattanooga, Tenn. 820
Wm. M. Crane Co., New York City. 821

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn. 820

STREET LAMPS.

Thos. T. W. Miner, New York City 821
Welsbach Street Lighting Co., New York and Phila. 826

(*Continued on page* 816.)

DIVIDEND NOTICE.

OFFICE OF THE AMERICAN GAS COMPANY,
222 S. THIRD ST., Philadelphia, Pa., May 20, 1903.

The Board of Directors of The American Gas Company has this day declared a semi-annual dividend of 3 per cent., or $3 per share, on the capital stock of the Company, payable on and after June 1, 1903.

1459-1 R. L. BABCOCK, Secretary.

MECHANICAL ENGINEER.

An experienced mechanical engineer, being an all-round, practical mechanic, designer of a well thought out line of modern, large

TANDEM GAS ENGINES,

in commercial sizes, between 100 and 1,000-horse power, adapted to drive electric generators at highest economy, using producer or waste furnace gases, or crude oil as fuel, desires connection with capital or manufacturing interests. Exceedingly large profits can be demonstrated to inquirers' own engineers. Four patents pending.

1457-4 Address, "Z. X. Y.," care this Journal.

WANTED,

Position as Superintendent of a Water Gas Plant,

In a town of about 18,000 population, by a man 43 years of age. Experienced in selling all kinds of gas appliances. Good reasons for wishing to make a change.

1459-2 Address, "J. F. S.," care this Journal.

GENERAL MANAGER.

A gas company wanting the services of a man who is practical in every department, and a developer of note, should correspond with "DEVELOPER,"

1459-2 Care this Journal.

WANTED,

Position as Manager of a Gas Company

That is much in need of a man thoroughly familiar with all details of the business. A position where the business and public confidence are much impaired, requiring the right man, at the right place, at the right time, preferred.

1458-tf Address, "ABILITY," care this Journal.

Position Wanted

AS MANAGER.

By a successful hustler for new business. Experienced in selling gas stoves; laying high and low pressure mains; understands the manufacture of coal and water gas in detail; also, reconstruction of benches and water gas apparatus. Superintendent of gas company for a number of years. Will find me up-to-date and energetic young man. Can furnish best of references. Address, "PUSHER,"

1457-5 Care this Journal.

TWO CAPABLE

Erecting Foremen

Wanted by
THE GAS MACHINERY COMPANY,
CLEVELAND, O.

Only experienced and capable men need apply.

1459-3

WANTED,

Two First-Class Pipe Fitters and One A-1 Canvasser for Gas Ranges.

Give references and state wages expected. None but first-class men need apply in either case.

Also Wanted--Indexes to Vols. 73 and 74, American Gas Light Journal.

Address, "R. W. P.,"

1429-3 Care this Journal.

WANTED,

A SKILLED GAS MAKER,

To operate 5-foot Lowe water gas apparatus. Permanent employment and good wages for the right man.

1459-2 Address, "GAS MAKER," care this Journal.

WANTED,

Manager for Gas and Electric Company in New York State.

Address, . . . "R. S. W.,"

1459-1 Care this Journal.

WANTED,

SERVICE FOREMAN.

One who understands setting meters, testing, and gas pipe work in general. Western city. Population, 30,000. State experience.

1459-tf Address, "F. H. W.," care this Journal.

FOR SALE, CHEAP.

Four purifying boxes, 6 feet by 6 feet by 2½ feet, with 6 inch connections. Complete, with seal and all connections.

One purifying box, 10 feet by 10 feet by 3 feet.

One 12-pipe condenser, 6½ feet long, 20 inches wide and 10 inches deep, with 6 inch connections. All in first class condition.

Address, MARQUETTE GAS LIGHT CO.,

1454-tf MARQUETTE, MICH.

FOR SALE.

One Set of 8 Feet by 10 Feet by 4 Feet Deep Purifiers.

Complete, with dry centerseal and all connections, ready for immediate shipment.

Address, ANN ARBOR GAS COMPANY,

1457-2 Ann Arbor, Mich.

FOR SALE.

5-FOOT WATER GAS APPARATUS.

Address, CHARLES G. M. THOMAS,

1449-tf Flushing, N. Y.

FOR SALE.

One High Pressure Roots' Exhauster and Engine,

On one bed. This machine is practically new, and has been delivering 100,000 per day, through 8 miles of 4-inch pipe line. Engine is direct connected to exhauster, and with them is included one cooling tank and all 8-inch connections.

1457-tf Address, "F. R. V.," care this Journal.

FOR SALE.

One 5 Feet 6 Inches Water Gas Set,

Complete in every detail. New in February. Will be operated until August, when larger machine will be ready. Address,

1458-3 MOHAWK GAS CO., Schenectady, N. Y.

FOR SALE,

One No. 6 Isbell-Porter Exhauster,

Almost new. Capacity per hour, 20,000 cubic feet, at 75 revolutions. Engine, 5 inches by 6 inches, and on same bedplate. Connections, 12 inch, with by-pass, tees and bends, and two 12-inch valves. Price, f.o.b. cars, $975.

Address, ROCHESTER GAS & ELECTRIC CO.,

1458-2 Rochester, N. Y.

FOR SALE, CHEAP.

One Set Single Superheater, Lowe Water Gas Apparatus.

Generator, 5 feet by 10 feet; superheater, 4 feet by 15 feet; scrubber, 2½ feet by 11 feet; washer, 4 feet by 2 feet, complete, with 8-inch connecting pipes; air blast valves, pressure gauges and distributing oil tank.

Address, BURLINGTON LIGHT & POWER CO.,

1459-tf Burlington, Vt.

FOR SALE, CHEAP.

One Set of 8-foot by 3-foot Deep Purifiers.

Eight-inch connection, 18-inch seal, complete, with Kerr Murray 4 way centerseal.

1459-4 PORT HURON GAS CO., Port Huron, Mich.

WANTED TO PURCHASE.

6½-foot by 6½-foot, or 7-foot Station Meter.

To be in good condition. State price, delivered f.o.b. at this point, duration of service, condition, etc. Immediate delivery.

CHARLOTTE ELECTRIC RAILWAY, LIGHT AND POWER COMPANY,

1459-2 CHARLOTTE, N. C.

WANTED, FOR IMMEDIATE USE,

Cast Iron Lamp Posts,

Of standard weight and design. Quote price, f.o.b. cars. State number.

Address, "MANUFACTURER,"

1459-2 Care this Journal.

WANTED,

To Lease or Buy

A coal gas works in a town of 10,000 to 20,000 inhabitants. Central or Middle West preferred. Replies strictly confidential.

1458-2 Address, "BUSINESS," care this Journal.

(*Concluded from page* 815.)

PURIFIERS.

Kerr Murray Mfg. Co , Fort Wayne, Ind..... 832
R. D. Wood & Co., Philadelphia Pa..... 834
Stacey Mfg. Co., Cincinnati, O 835
The Western Gas Construction Co., Fort Wayne, Ind... 800
Connelly Iron Sponge and Governor Co., New York City 783

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 783

VALVES.

Continental Iron Works, Brooklyn, N. Y..... 834
Isbell-Porter Co., NewYork City..... 834
Kerr Murray Mfg. Co., Fort Wayne, Ind 832
Ludlow Valve Manufacturing Co., Troy, N.Y..... 821
R. D. Wood & Co., Philadelphia, Pa..... 834
The P. H. & F. M. Roots Co., Connersville, Ind..... 823
The Western Gas Construction Co., FortWayne, Ind... 800

EXHAUSTERS.

Connelly Iron Sponge and Governor Co., New York City 783
Isbell-Porter Company, New York City..... 834
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 832
The Connersville Blower Company, Connersville, Ind... 833
The P. H. & F. M Roots Co., Connersville, Ind..... 823

ELECTRICAL APPARATUS.

Wm. Henry White, New York City..... 835

PURIFIER SCREENS.

John Cabot, New York City..... 829

GAS STOVES.

American Meter Co., New York and Philadelphia..... 825
Keystone Meter Co., Royersford, Pa..... 838
Maryland Meter and Manufacturing Co., Baltimore, Md 838
Nathaniel Tufts Meter Co., Boston Mass..... 838

HOT WATER HEATERS.

The Humphrey Mfg. and Plating Co., Kalamazoo, Mich. 814

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N.Y..... 832

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 835
Continental Iron Works, Brooklyn, N.Y..... 834
Davis & Farnum Mfg. Co., Waltham, Mass..... 842
Delly & Fowler, Philadelphia, Pa..... 836
Kerr Murray Mfg. Co., FortWayne, Ind..... 832
Logan Iron Works, Brooklyn, N Y..... 836
R. D. Wood & Co., Philadelphia, Pa..... 834
Riter-Conley Mfg. Co., Pittsburg, Pa..... 835
Stacey Mfg. Co., Cincinnati, O..... 835

STORAGE TANKS.

Christopher Cunningham, Brooklyn, N.Y..... 829

AUTOMATIC SCALES.

Richardson Scale Co., New York City..... 820

INVESTORS.

W. R. Faben Construction Company, Toledo, O..... 820

PATENTS, TRADE-MARKS, COPYRIGHTS.

Royal E. Burnham, Washington, D. C..... 820

Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.
IMPROVED AMMONIA CONCENTRATOR.
About 100 in use. Write to
STROH & OSIUS, Patentees, or
MICHIGAN AMMONIA WORKS, - Detroit, Mich.

1903. NEW DETROIT 1903.

Force Draft

ARC GAS LAMP,

With double flash pilot. We save 25 per cent. gas over any other arc and produce more candle power. To light consumption what the gas range is to fuel.

A Handsome Fixture. Always in Order.

We will send one or more lamps on 30 days' trial to Gas Companies who maintain the lamps. Write for quotations and circulars. We will save you money.

Detroit Arc Gas Light Company,

67-71 Michigan Avenue, Detroit, Mich.

Bronder Patent Stoking Machinery.

Three-Scoop and Three-Rake Charging and Discharging Machines are operating in New York, Newark, N. J., Philadelphia, Worcester, Mass., Mt. Vernon, N. Y., Toronto and Montreal, Canada.

Four-Scoop and Four-Rake Charging and Discharging Machines are being furnished for Detroit, Mich.

These are the only machines that will draw or charge simultaneously three or four retorts (vertically) and handle from 42 to 60 retorts in from 25 to 30 minutes, lid opening and closing and filling of furnaces included.

Hot Coke Conveyor, Quencher and Steam Exhauster, operating in Toronto, Can., working in water-sealed flue, rollers being protected from heat and grit.

COAL CRUSHERS, CONVEYORS AND BINS. TURNTABLES FOR MACHINES.

Labor-Saving Machines for Handling Coal and Coke from Coal Cars to Coke Yard or Bins, a Specialty.

G. A. BRONDER,

Contracting Engineer and Builder,

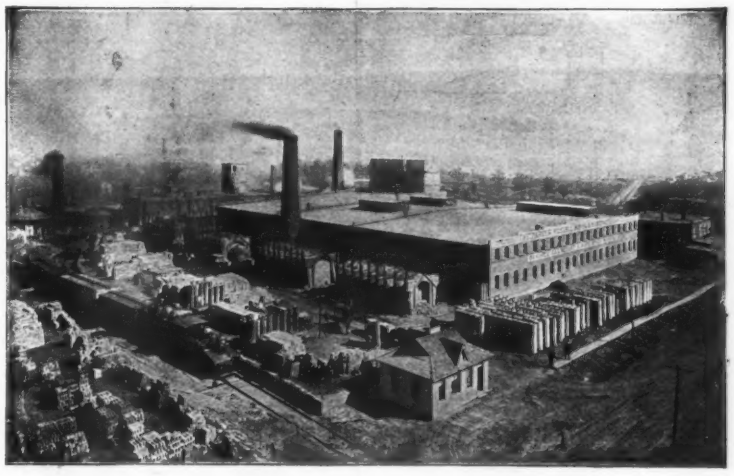
229 BROADWAY, NEW YORK.

PARKER-RUSSELL MINING AND MFG. CO.,

PROPRIETORS OF THE

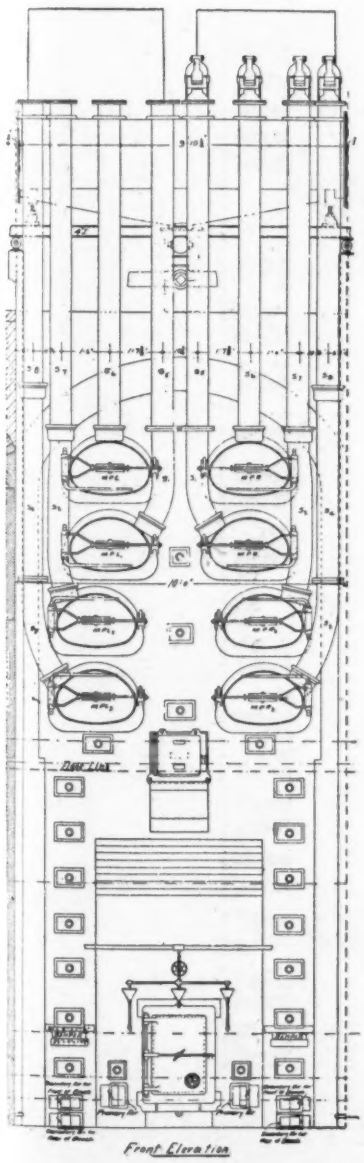
OAKHILL GAS RETORT AND FIREBRICK WORKS.

St. Louis Office:
417 Pine St.



FACTORY AT ST. LOUIS, MO.

New York Office:
Aldrich Court,
45 Broadway.



WE MAKE A SPECIALTY OF WATER GAS LININGS AND CHECKER BRICK.

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

SLOPERS.--We have perfected plans of INCLINED RETORT BENCHES, designed to meet conditions prevailing in America, and constructed entirely of American materials.

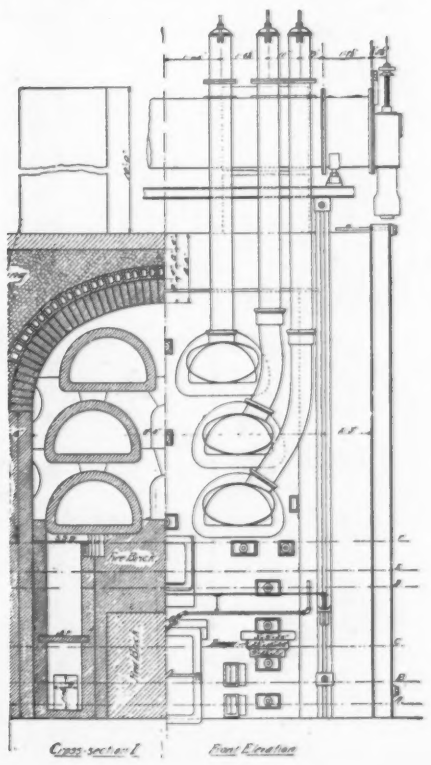
We build Benches complete, ready for gas making. Also

RETORT HOUSES,

COAL AND COKE CONVEYING MACHINERY.

Plans, Specifications and Estimates cheerfully furnished.

CORRESPONDENCE SOLICITED.



ADAM WEBER SONS.

BUILDERS AND CONSTRUCTORS OF THE

"MAURICE GRAHAM" SYSTEM OF

INCLINED RETORT

INSTALLATIONS COMPLETE.

WE HAVE A STAFF OF EXPERIENCED AND TRAINED ENGINEERS TO ERECT THIS SYSTEM.

THE LARGEST INSTALLATIONS IN THE WORLD WITH 20-FOOT RETORTS AND BENCHES OF 9'S IN ACTION. NOW OPERATING AT EDINBOROUGH, LEEDS, MILAN, PARIS, LONDON, ETC.

GRAHAM'S PATENT HOT COKE CONVEYOR.

FOR QUENCHING AND DRYING THE COKE DURING TRANSIT.

See Articles in AMERICAN GAS LIGHT JOURNAL, February 9th and 16th, 1903.

The Ball Check.

Pat. Nov. 25, 1902.

ANY BURNER.

ANY GAS--ANY PRESSURE.
INSTANT ADJUSTMENT.

HIGHEST EFFICIENCY.

"JUST A TWIST OF YOUR WRIST AND YOUR LIGHT IS BRIGHT."

"THE BALL DOES IT ALL."

Triple Arc Ball Check Lamp fits any chandelier or gas bracket. Three times the light of the single mantle burner, yet burns only double the amount of gas. More light—less gas. Greatest illuminator in the world for the money.

Send for the Ball Check Light Booklet.

BALL CHECK LIGHT CO.,
16 AND 18 PARK PLACE,
NEW YORK.

NEW ENGLAND BALL CHECK LIGHT CO.,
161 FRANKLIN STREET,
BOSTON.

FRANK D. MOSES

Long Distance Telephone, 1922, Trenton, N. J.

TRENTON, N. J.,

Long Distance Telephone, 1922, Trenton, N. J.

Constructing Engineer and Contractor.

Estimates Furnished on any kind of Work in Connection with Gas or Water Plants.

SPECIAL ATTENTION GIVEN TO THE REMODELLING AND EXTENDING OF THE PROPERTIES OF WORKS NOT UP-TO-DATE.

CORRESPONDENCE SOLICITED.

P. PLANTINGA, President. W. E. STEINWEDELL, Secretary.

THE GAS MACHINERY CO.,

OFFICES: 720-722 CITIZENS BUILDING,

CLEVELAND, OHIO.

Coal and Water Gas Apparatus, Bye-Product Machinery, Structural Work and Connections.

See Articles in AMERICAN GAS LIGHT JOURNAL

STEWARD BURNERS.

6 SIZES.
5 PRESSURES.

Made with a check to consume rated amounts accurately.

SIZES, - 1½, 2, 3, 4, 5, 6 feet. - - - PRESSURES, - 8/10, 12/10, 15/10, 20/10, 25/10.

THE D. M. STEWARD MFG. CO., ESTABLISHED 1876.

NEW YORK: 8-12 Jay Street. CHICAGO: 57 Washington Street. FACTORY AND GENERAL OFFICE: Chattanooga, Tenn.

Gas Analyses of All Sorts and Conditions,

—OR—

Analyses of Solid and Liquid Materials as Well,

That are needed by Gas Companies at any time in the conduct of their business, may be obtained from

DR. W. H. BIRCHMORE,

1421-tf 341 ADELPHI ST., BROOKLYN, N. Y.

IN THE MARKET.

WE PURCHASE:

Gas properties,
Electric light properties.
Street railway properties.
Also desirable franchises.

W. R. FABEN CONSTRUCTION CO.,

1383-tf 317 St. Claire Street, Toledo, O.

PATENTS, TRADE-MARKS, COPYRIGHTS.

ROYAL E. BURNHAM,

Solicitor of Patents and Counsellor in Patent Causes.

833 Bond Building, Washington, D. C.

Send for Pamphlet on Patents.

1448-tf

AUTOMATIC SCALES

Send for Catalogue.

RICHARDSON SCALE CO., 21 Park Row, NEW YORK CITY.

GAS BURNERS,

To burn a given amount at a stated pressure, made to order. Samples furnished. Also, small oil and air valves, slow-feed valves for high pressure, and small brasswork in general.

Drip Pumps, Service Cleaners, Gasfitters' Proving Pumps and Mercury Gauges.

C. GEFRORER & SON,

248 North 8th Street, Philadelphia, Pa.

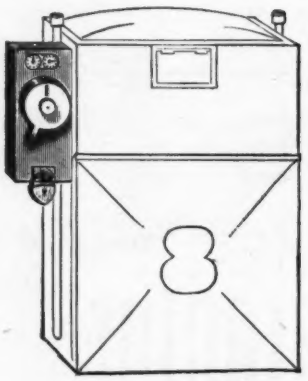
HUGHES' "GAS WORKS,"

Their Construction and Arrangement, and the Distribution of Coal Gas.

Originally written by SAM'L HUGHES, C.E. Rewritten and much enlarged by WM. RICHARDS, C.E.

Eighth Edition, Revised, with Notices of Recent Improvements. **Price, $1.65.**

A. M. CALLENDER & CO., 42 PINE ST., N. Y. CITY.



THE **REEVES PREPAYMENT ATTACHMENT**

HAS ADVANTAGES POSSESSED BY NO OTHER DEVICE OF THE KIND.

FATAL ACCIDENTS

CAUSED BY CONSUMERS PUTTING COIN IN METER AND SO TURNING GAS ON IN SLEEPING ROOMS WHERE IT HAD GONE OUT **CANNOT OCCUR** WITH THE **REEVES,** AS THE LIGHT DROPS TO A VERY SMALL ONE, BUT DOES NOT GO OUT FOR 10 OR MORE HOURS, AND AMOUNT OF GAS SO USED IS AUTOMATICALLY DEDUCTED FROM NEXT PREPAY. HAS OTHER GREAT ADVANTAGES. FITTED TO ANY MAKE OF METER. $10 CAN BE PREPAID AT ONE TIME. DEVICE CANNOT BE **"BEATEN."**

REEVES MFG. CO., - - - NEW HAVEN, CONN.

FRED. BREDEL, President. WM. O. VILTER, Vice-President. O. W. GREENSLADE, Secretary and Treasurer.

FRED. BREDEL COMPANY,

ENGINEERS AND BUILDERS OF GAS PLANTS.

Inclined Benches, own system, Recuperative Furnaces, Exhausters, Exhauster Governors, Condensers, Washers, Coolers, Wet Purifying Plants, Purifiers, Oxide Elevators, Hydraulic and Dry Coke Conveyors.

Special High Grade Material for Recuperative Furnaces.

Licensees for ARROLL-FOULIS Charging and Discharging Machines and FRONHAUSER Coke Conveyors. OFFICE, 405 KEENE ST., MILWAUKEE, WIS.

COAL TAR AND AMMONIA.

THIRD AND ENLARGED EDITION.

BY

GEORGE LUNGE, PH.D.

Price, $15. For Sale by

A. M. CALLENDER & CO., - - 42 Pine Street, New York City.

Have you seen BRAY'S

New "ELTA" Burners?

These are the only Acetylene Burners which can be turned high or low without carbonizing, and, therefore, they remove one of the greatest barriers to the progress of lighting by Acetylene. Write for further information.

WILLIAM M. CRANE COMPANY,

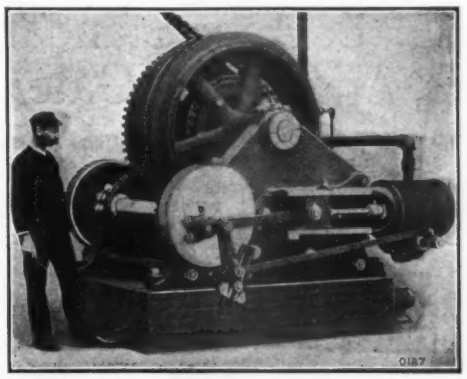
SOLE AGENTS FOR THE UNITED STATES,

1131 Broadway, New York.

"Hunt" Hoisting Engines

Combine economy of steam with durability in service.

Write for Catalog 0117.



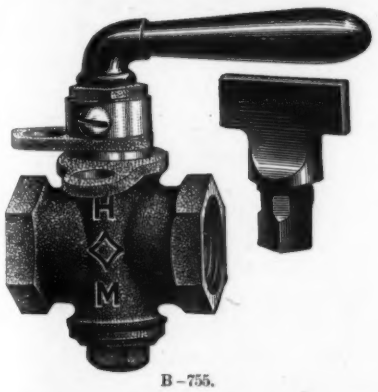
This style of engine is especially designed for rapid and economical coal hoisting from vessels, with ordinary self-dumping tubs.

C. W. Hunt Co.,

West New Brighton, N. Y.

New York Office: 45 BROADWAY.

Mueller Gas Cocks.



B-755.

TOO little is not as much as you pay for, and too much is more paid for than you need.

In **Mueller Gas Cocks** you find a happy medium--not so little metal as to leave them weak, nor yet so much as to make them costly.

Made in 145 styles, seven sizes in each style.

MADE ONLY BY

H. MUELLER MFG. CO.,

DECATUR, ILLS., U. S. A.

THE

Ludlow Valve Mfg. Co.,

TROY, N. Y., U. S. A.

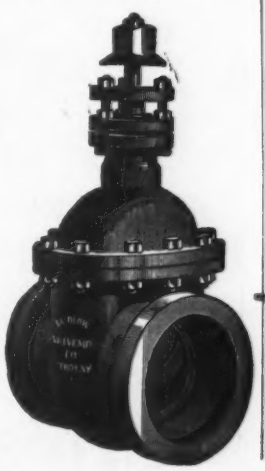
Double and Single Gate Valves, ¼" to 72",

—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.

HOT GAS VALVES A SPECIALTY.

Send for Catalogue.



"THE MINER"

Globe Street and Boulevard **Lamps.**

Cheapest and Best.

THOUSANDS IN USE WITH INCANDESCENT BURNERS.

Send for Catalogues.

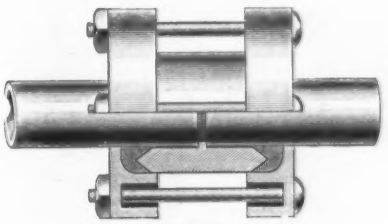
THOMAS T. W. MINER

821-823 Eagle Av., N.Y

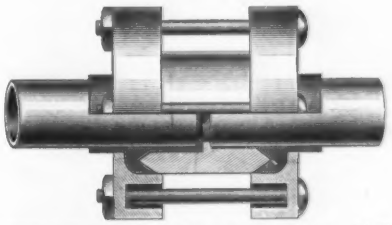
S. R. DRESSER,

BRADFORD, PENNSYLVANIA, U. S. A.,

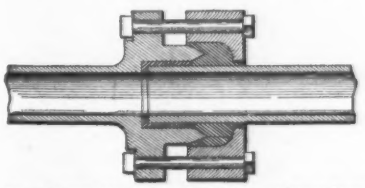
Patentee and Manufacturer of Specialties for Oil and Gas Lines.



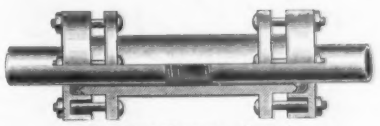
Regular Coupling. Style 1.



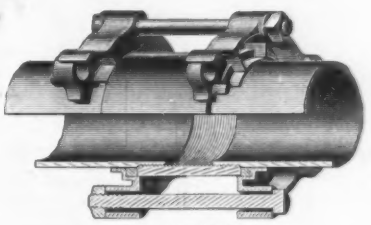
Insulating Coupling for Wrought Iron Pipe Style 5



Insulating Coupling for Bell and Spigot Cast Iron Pipe Style 6.



Regular Sleeve. Style 2.



Clamp. Style 4.

Pipe Couplings, Sleeves, Clamps, Crosses, Tees and Ells.

My Insulating Coupling prevents the destruction of pip by electrolytic action, in either water or gas lines.

SEND FOR CATALOGUE.

LLOYD CONSTRUCTION COMPANY,

DETROIT, MICH.

LOWE DOUBLE SUPERHEATER WATER GAS APPARATUS.

Coal Gas Condensing and Scrubbing Apparatus.
Purifiers with Plain or Reversing Center Valves.
The Lloyd System of Valve Connections.
PLAIN OR REVERSING (PATENT APPLIED FOR).
Oxide, Coal and Coke Elevators and Machinery.
Pipe Specials, all sizes. A. G. L. Asn. Standard.
Structural Steel Work, Floors, Angle and Gate Valves.

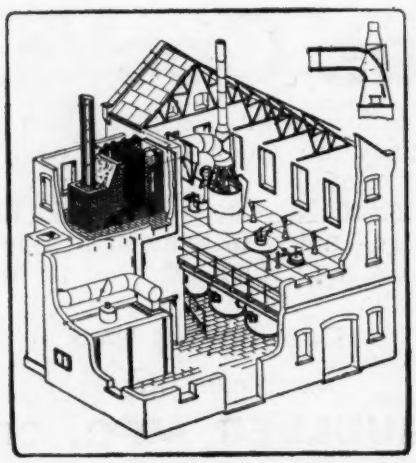
General Western Agents for BARTLETT, HAYWARD & CO., Baltimore, Md.

COAL GAS CONDENSATION SYSTEM. THE "MAYER" PATENTED TAR EXTRACTOR. THE STANDARD ROTARY WASHER-SCRUBBER. STETTIN SYSTEM INCLINED BENCHES, HYDRAULIC VALVES, ETC., ETC.

Economize Heat in Water Gas Plants,

BY UTILIZING A

Green's Economizer,



To absorb the heat now going to waste when you blow through your superheater to heat the feed water for your boilers to the temperature of the steam. This is now being done at the Poughkeepsie Gas Works, Poughkeepsie, N. Y.

Write for full particulars how this is accomplished, the saving effected, and the advantages gained, to the

GREEN FUEL ECONOMIZER CO.,
MATTEAWAN, N. Y.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE

Plans prepared and Estimates furnished at short notice.

J. P. WHITTIER,
238 Java Street, Brooklyn, N. Y.

GEORGE R. ROWLAND,

Formerly with the Continental Iron Works.

Draughtsman and Constructing Engineer.

Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.

Office, No. 245 Broadway, N. Y. City.

Chollar's System of Gas Purification.

THE PURIFIED GAS REVIVES THE FOULED OXIDE.

THE GAS ENGINEERS' POCKET-BOOK.

By Henry O'Connor,

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

PRICE, $3.50.

A. M. CALLENDER & CO., No. 42 Pine Street, New York City.

The Advertisement of the

CONNELLY IRON SPONGE AND GOVERNOR COMPANY,

395 Broadway, New York City,

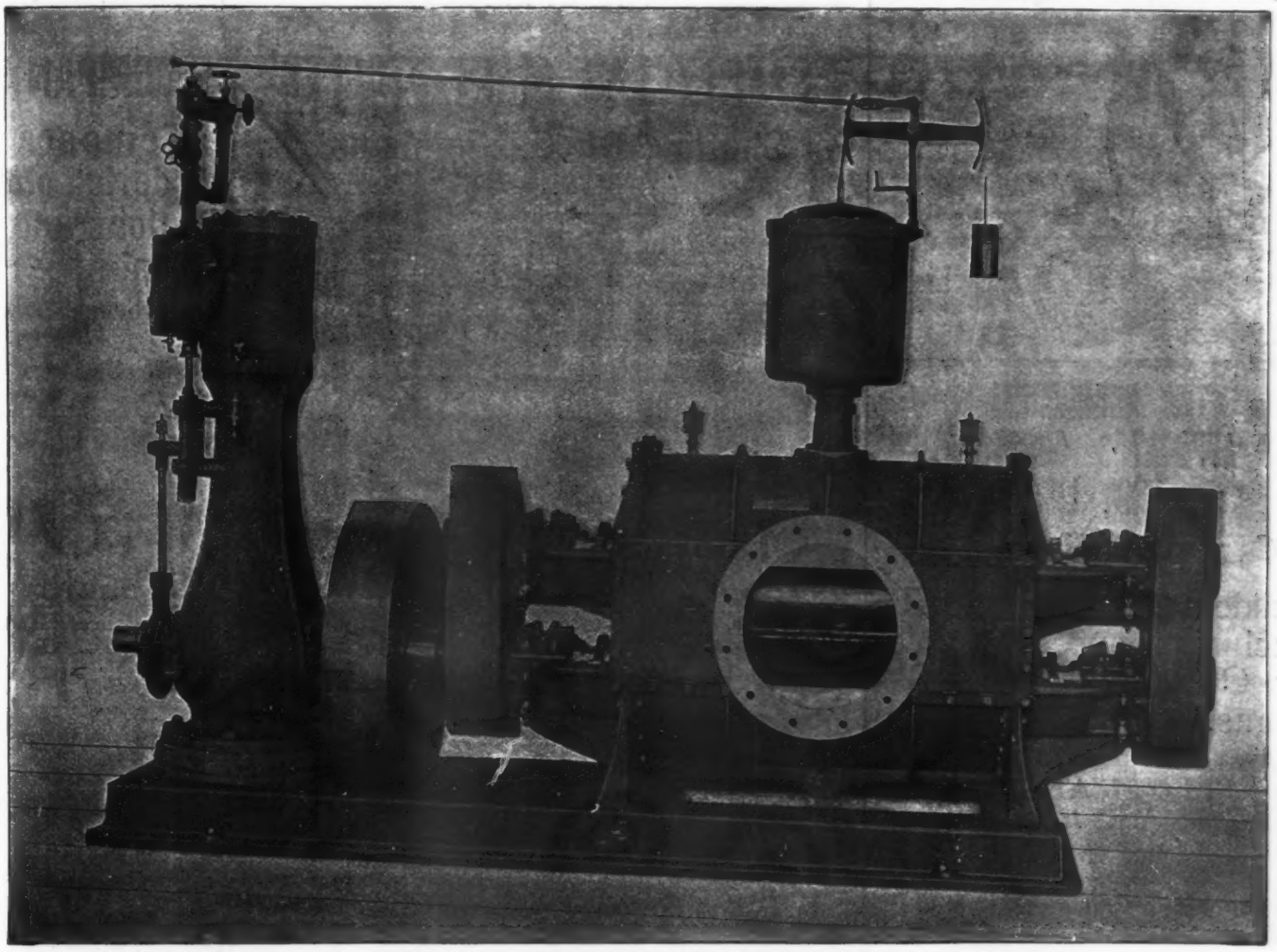
Occupies this Space Every Alternate Week.

ROOTS'

NEW GAS EXHAUSTER.

Always in the lead. Always anticipating the requirements of the trade. Our new Exhauster meets all demands of modern gas making and overcomes all difficulties heretofore experienced.

OUR GAS GOVERNOR IS MAKING FRIENDS EVERY DAY.



P. H. & F. M. ROOTS CO.,

Connersville, Ind. 120-122 Liberty St., New York.

Eastern Office:

CONNELLY IRON SPONGE AND GOVERNOR CO., 395 BROADWAY, NEW YORK CITY.

"Globe" Specials, Valves, Etc. "Glamorgan" Pipe and Specials

M. J. DRUMMOND & CO.

MANUFACTURERS OF

CAST IRON

FLANGE

GAS AND WATER PIPE

GENERAL SALES OFFICE, 192 BROADWAY, NEW YORK.

GEORGE ORMROD, Mangr. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa.

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA.

CAST IRON GAS & WATER PIPE

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

GAS TAPPING MACHINES

—FOR—

Drilling and Tapping Pipe under Pressure

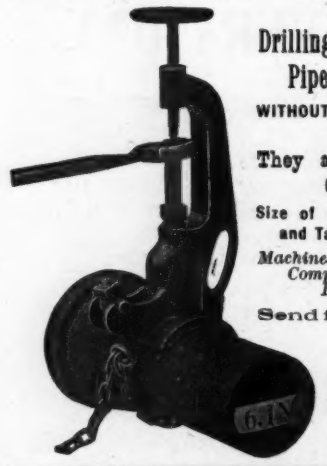
WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

Send for Circulars.



Geo. Light, DAYTON, O.

THE ECONOMICAL GAS APPARATUS CONSTRUCTION COMPANY, LIMITED,

Consulting Engineers.

Builders of UP-TO-DATE Machinery and Appliances for Coal and Water Gas Plants. :: :: :: :: ::

PLANS, SPECIFICATIONS AND ESTIMATES PREPARED.

AMERICAN OFFICE:
269 Front St., East, Toronto, Canada.

THE

Valuation of Gas, Electricity and Water Works

FOR ASSESSMENT PURPOSES.

THOS. NEWBIGGING, M.Inst.C.E., and WM. NEWBIGGING, Assoc.M.Inst.C.E.

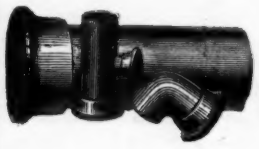
With an Appendix of Decided Cases.

Second Edition. Price $2. For Sale by

A. M. CALLENDER & CO.,
42 Pine Street, N. Y. City.

WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.



New York Office, 160 Broadway.

CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

CHARLES MILLAR & SON CO., Selling Agents, Utica, N.Y.

Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, Jute, etc.

UTICA PIPE FOUNDRY CO.

Manufacturers of Lead Pipe, Solder, etc., and Jobbers of Plumbers' and Tinners' Goods.

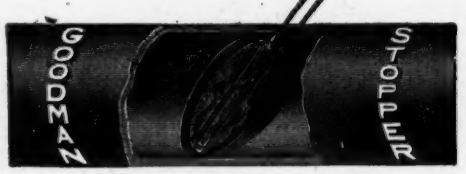
CAST IRON PIPE and SPECIALS FOR WATER AND GAS

Wholesale Eastern Agents AKRON VITRIFIED SEWER PIPE.

SAFETY GAS MAIN STOPPER COMPANY,

For Shutting Off Gas in Mains Temporarily during alterations and repairs. : : : :

Any size gas main can be shut off in 30 seconds. : : :



STOPPERS SENT ON TRIAL.

Address: SAFETY GAS MAIN STOPPER CO., 108 E. 117th St., New York City.

THE No. 8

Humphrey Crescent Instantaneous Water Heater

IS A QUICK SELLER.

PRICE,

$20.00.

SHELF AND BRACKET FREE.

HAS NO EQUAL AT THE PRICE.

TRY ONE AND BE CONVINCED. WILL SEND ON 60 DAYS' APPROVAL.

HAVE YOU OUR CATALOGUE?

The Humphrey Mfg. and Plating Co.,

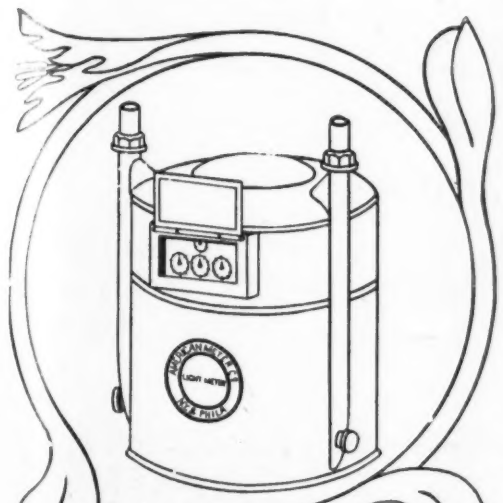
KALAMAZOO, MICH., U. S. A.

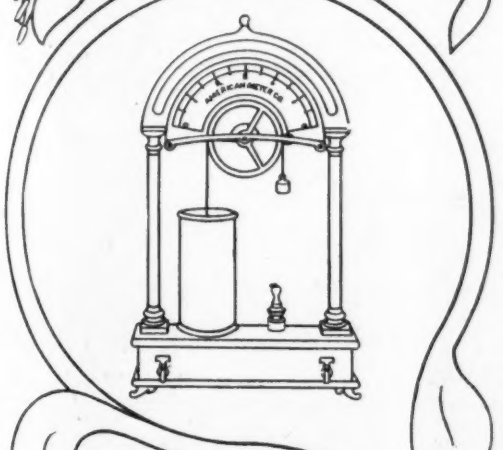
(Copyrighted, 1894, by the AMERICAN METER CO.)

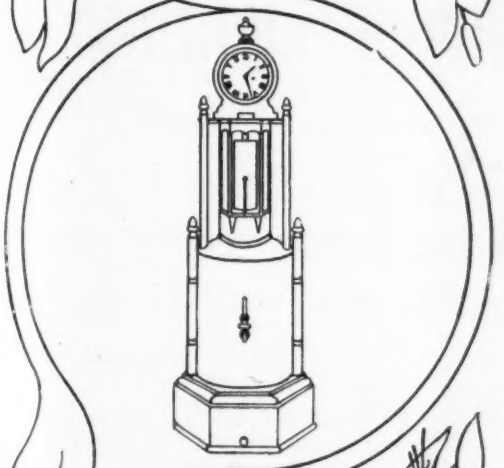
AMERICAN METER CO.

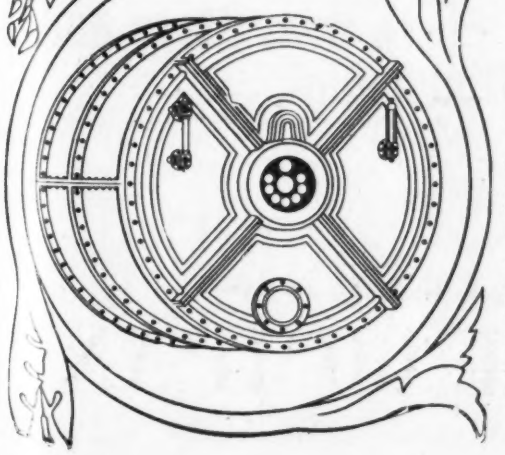
ESTABLISHED 1834. INCORPORATED 1868.

NEW YORK,
PHILADELPHIA,
CHICAGO,
ST. LOUIS,
SAN FRANCISCO.









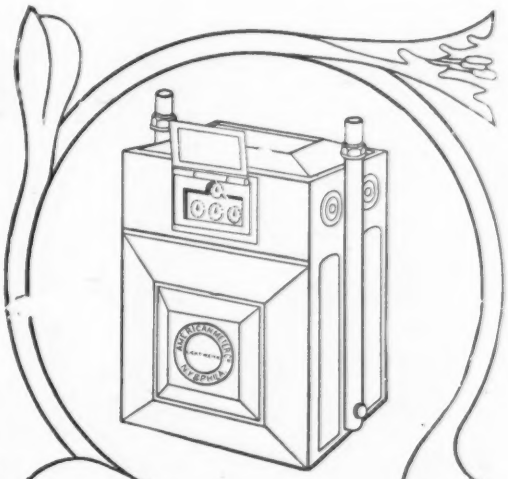
PUBLIC LIGHTING TABLE.

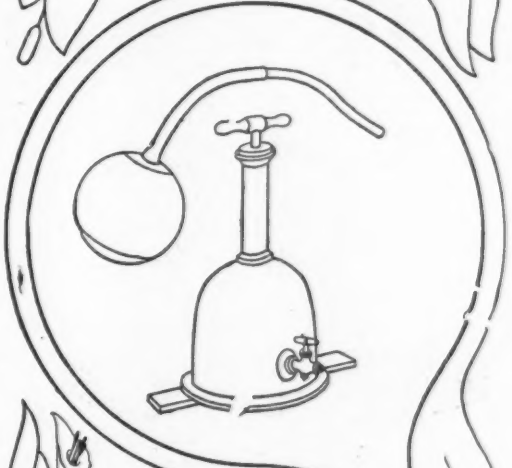
JUNE, 1903.

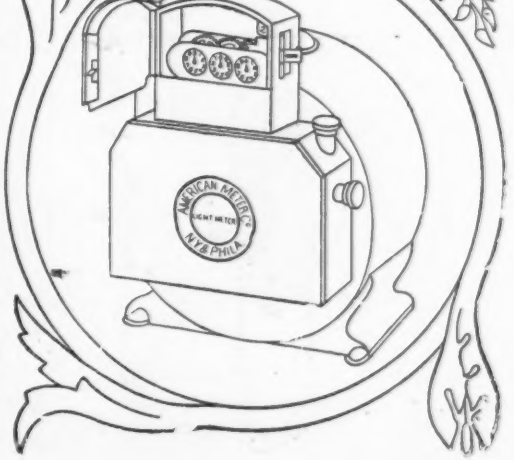
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light. P.M.	Table No. 2. New York City. All Night Lighting. Extinguish. A.M.
Mon.	1	11.10 PM	3.30 AM	7.15	3.15
Tue.	2	11.40 FQ	3.30	7.15	3.15
Wed.	3	12.20 AM	3.30	7.15	3.15
Thu.	4	12.50	3.30	7.25	3.15
Fri.	5	1.30	3.30	7.25	3.15
Sat.	6	2.00	3.30	7.25	3.15
Sun.	7	2.40	3.30	7.25	3.15
Mon.	8	No L.	No L.	7.25	3.15
Tue.	9	No L. FM	No L.	7.25	3.15
Wed.	10	No L.	No L.	7.25	3.15
Thu.	11	8.00 PM	9.30 PM	7.25	3.15
Fri.	12	8.00	10.20	7.25	3.15
Sat.	13	8.00	10.50	7.25	3.15
Sun.	14	8.00	11.30	7.25	3.15
Mon.	15	8.00	12.00	7.25	3.15
Tue.	16	8.00	12.30 AM	7.25	3.15
Wed.	17	8.00 LQ	1.00	7.25	3.15
Thu.	18	8.00	1.30	7.30	3.15
Fri.	19	8.00	2.00	7.30	3.15
Sat.	20	8.00	2.40	7.30	3.15
Sun.	21	8.00	3.30	7.30	3.15
Mon.	22	8.00	3.30	7.30	3.15
Tue.	23	8.00	3.30	7.30	3.15
Wed.	24	8.00 NM	3.30	7.30	3.15
Thu.	25	8.00	3.30	7.30	3.15
Fri.	26	8.00	3.30	7.30	3.15
Sat.	27	8.00	3.30	7.30	3.15
Sun.	28	8.00	3.30	7.30	3.15
Mon.	29	9.50	3.30	7.30	3.15
Tue.	30	10.20	3.30	7.30	3.15

TOTAL HOURS LIGHTING DURING 1903.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	245.00	January	423.20
February	192.00	February	355.25
March	201.00	March	355.35
April	167.20	April	298.50
May	152.00	May	264.50
June	131.00	June	234.25
July	140.40	July	243.45
August	156.20	August	280.25
September	171.20	September	321.15
October	198.20	October	374.30
November	216.30	November	401.40
December	232.10	December	433.45
Total, yr.	2203.40	Total, yr.	3987.45



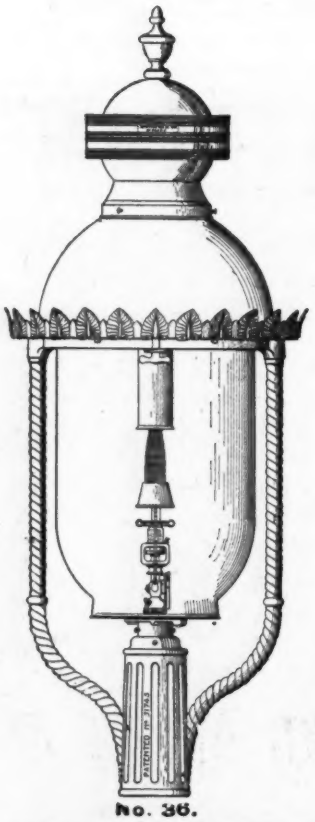




NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others Interested in Municipal and Outside Lighting.

No. 38.

The Welsbach Gas Arc for Indoor Lighting.

The cut tells the story—but not all of it. Get one lamp and light it—then the tale's told from beginning to end. For one Welsbach Gas Arc Lamp is a better salesman than 20 pages of advertising.

Here's what it would show if you give it a chance to prove its worth:

1. A mechanical construction and finish that insures the greatest durability.
2. The renewal of mantles and the cleaning of globes without removal of globe.
3. The greatest amount of candle power with least consumption of gas.
4. A by-pass cock so constructed as to permit all or only one mantle burning at a time.
5. A pilot light that consumes but 1 foot of gas in 24 hours. Costs $\frac{1}{10}$ of a cent a day.

Give it a Chance to Tell its Own Story and it Won't Disappoint.

Let us send you one lamp—doesn't cost a fortune—and it will answer every question you put to it; make good on every test given it. You know the only proof of the pudding? What's the use in a fellow telling you it tastes good? Taste it yourself, then you know.

May we Send you ONE Lamp?

WELSBACH COMPANY,

GLOUCESTER, N. J., and CHICAGO, ILL.

THE UNITED GAS IMPROVEMENT COMPANY

During the Year 1902 has been Awarded Contracts in the Following Places for

Standard Double-Superheater Lowe Water Gas Apparatus.

Atlantic City, N. J.	Flushing, N. Y.	Norristown, Pa.
Ardmore, Pa.	Hollidaysburg, Pa.	Norwalk, O.
Auburn, N. Y.	Houston, Tex.	Ocean City, N. J.
Belmar, N. J.	Indianapolis, Ind.	Oklahoma City, O. T.
Blue Island, Ills.	Jersey City, N. J.	Oneonta, N. Y.
Boonton, N. J.	Laconia, N. H.	Plainfield, N. J.
Brooklyn, N. Y.	Lakewood, N. J.	Portland, Me.
Carlisle, Pa.	La-Salle-Peru, Ills.	Pottsville, Pa.
Champaign, Ills.	Martinsville, Ind.	Scranton, Pa.
Coney Island, N. Y.	Memphis, Tenn.	South Brooklyn, N. Y.
Dallas, Tex.	Newark, N. J.	Suffern, N. Y.
Danville, Ills.	New Brunswick, N. J.	Swedesboro, N. J.
Des Moines, Ia.	New London, Conn.	Syracuse, N. Y.
Evanston, Ills.	New Orleans, La.	Washington, N. C.
Evansville, Ind.	Norfolk, Va.	Woonsocket, R. I.

TOTAL SETS, 1902, ... 51
TOTAL DAILY CAPACITY, 1902, . . 32,825,000 cubic feet.
TOTAL SETS TO DATE, ... 447
TOTAL DAILY CAPACITY, ... 299,670,000 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. L. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES, FIRE BRICK and FIRE CLAY SPECIALTIES

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

Brooklyn Fire Brick Works,

OFFICE AND WORKS:
88 VAN DYKE ST., BROOKLYN, N. Y.
MANUFACTURERS OF

CLAY GAS RETORTS & SETTINGS, GENERATOR LININGS. SPECIALTIES.

Established 1854. Incorporated 1869.

LACLEDE
Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

Office:
Cor. Manchester and Sulphur Avenues, St. Louis, Mo.

Established 1845. Reorganized 1902.

The Kreischer Brick Mfg. Co.,

Manufacturers of the very best quality of Clay Retorts, Blocks, Tiles, Settings and Firebrick of every description.

Also Miners and Shippers of Fireclay, Fire Sand, Ground Brick in Barrels.

WORKS: KREISCHERVILLE, STATEN ISLAND.
OFFICE: 119 E. 23D STREET, NEW YORK CITY.

Adam Weber Sons,

Works, Weber, N. J.
Main Offices, Park Row Bldg., New York.

Modern Recuperative Furnaces.

Standard Fire Brick and Gas Retorts.

OSCAR B. WEBER'S

Construction Vertical 8's (Patented). First Instalment in the World with Modern Charging and Discharging Machinery.

AGENTS FOR

GRAHAM, MORTON & CO.
LEEDS ENGLAND,
INCLINED RETORT SYSTEM.

Perforated Radial Block Chimneys.

AGENCIES.
HERBERT B. HAM, 80 Water Street, Boston, Mass.
BAKER ENGINE AND MACHINE CO., 114 N. 3d St., Phila., Pa.
JOHN T. WHEELER, 933-934 Monadnock Bldg., Chicago, Ills.

ISAAC C. BAXTER, President. ESTABLISHED 1864. PETER YOUNG, Sec'y and Treas.

Works.
LOCKPORT STATION, PA.

JAMES GARDNER, JR., CO.,

Address all communications to
JAMES GARDNER, JR., CO., Room 202 Lewis B'l'dg.
PITTSBURGH, PA.

Successor to WILLIAM GARDNER & SON.

Fire Clay Goods for Gas Works.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg, Ills., or Buffalo, N. Y.
In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

The Gas Engineer's Pocket-Book,

By HENRY O'CONNOR.

Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works.

PRICE, $3.50.

For Sale by

A. M. CALLENDER & CO., 42 Pine Street, New York City.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE
RETORT & FIRE BRICK CO.

MANUFACTORY AT
LOCUST POINT, BALTIMORE, MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY, AND FIRE CEMENT.

Our Improved Half and Full Dept Benches have been Adopted by Many Gas Companies.

WALDO BROS., 102 MILK ST., BOSTON, MASS.

Sole Agents for New England States.

JOHN DELL,
President and General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

MANUFACTURERS OF

Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are the **Exclusive Agents** *for the* **Mitchell Patent Benches,** *Constructed with Half or Full Depth Furnaces, to Burn either Coal or Coke, and Arranged for Front or* **Rear Clinkering.** **The Mitchell** *is the* **Original Coal Firing Bench.** *We also Erect Plain Benches with* **One** *to* **Six Retorts.**

YOUR CORRESPONDENCE IS RESPECTFULLY SOLICITED.

City Office:
411 Olive Street,
Continental Bank,
ST. LOUIS, MO.

CHRISTOPHER CUNNINGHAM,

PROPRIETOR,

THE NOVELTY STEAM BOILER WORKS,

BROOKLYN, N. Y.

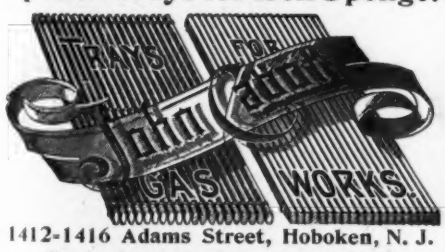
STORAGE TANKS FOR GAS WORKS,

To Retain Fluid Material of Any Sort.

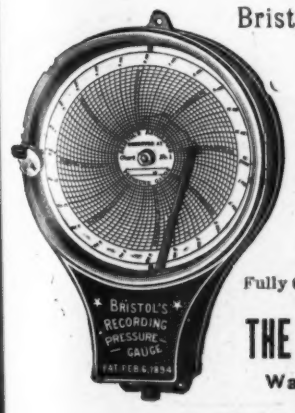
PIPING IN AND AROUND GAS WORKS.

Work Done for Several of the Largest Gas Companies in America Stands as Reference.

Church's Patent Trays.
Reversible; Strongest; Most Easily Repaired.
Special Trays for Iron Sponge.



1412-1416 Adams Street, Hoboken, N. J.
We also Supply the Chapest and Strongest
•Reversible Bolted Trays•
IN THE MARKET.
SEND FOR BOOKLET AND CIRCULARS.

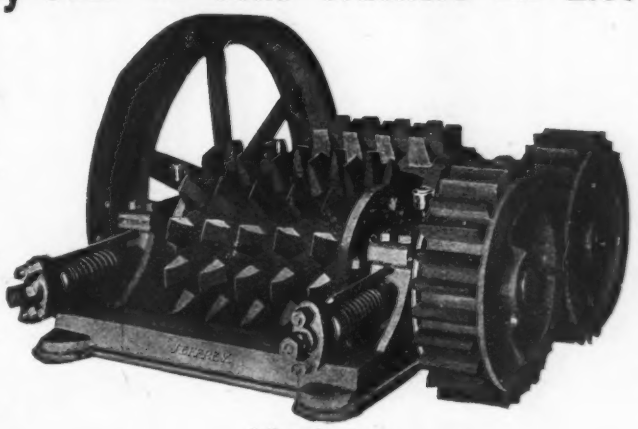


Bristol's Recording
PRESSURE GAUGE.
For continuous records of
Street Gas Pressure.
Simple in construction, accurate in operation and low in price.
Fully Guaranteed. Send for Circulars.
THE BRISTOL CO.,
Waterbury, Conn.

Silver Medal, Paris Exposition.

Jeffrey Coal and Coke Crushers and Elevators.

Screens.
Chains.
Wheels.
Dump Cars.
Send for Catalogue.



Jeffrey Crushers.

Elevator Buckets.
Rubber Belt Conveyors.
Chain Conveyors.
Our Prices will Interest you.

ADDRESS,
THE JEFFREY MANUFACTURING CO.,
COLUMBUS, OHIO, U. S. A.
New York, Chicago, Denver, Buffalo, Philadelphia, Butte, Mont., Kansas City, St. Louis.

The Gas Engineer's Laboratory Handbook,
By JOHN HORNBY, F.I.C. Price, $2.50.
Orders may be sent to
A. M. CALLENDER & CO., 42 Pine St., N. Y.

JAMES D. PERKINS, President. F. SEAVERNS, Treasurer.

THE PERKINS COMPANY,

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING:

Ocean Mine Youghiogheny Gas Coal,
Old Kentucky Shale and O. K. Boghead.

SHIPMENTS FROM NEW YORK, PHILADELPHIA, BALTIMORE AND NORFOLK

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:
Washington Building, New York.
Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully Prepared.
For Gas Making or
Heavy Steaming. .

A. C. M. AZOY, General Agent, 1 Broadway, New York.

Gulf Refining Company

REFINERS OF

TEXAS PETROLEUM

HIGH GRADE

GAS OIL

A SPECIALTY

REFINERIES AT
PORT ARTHUR, TEX

GENERAL OFFICES
FRICK BUILDING
PITTSBURG, PA

KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

Do You Wish to Know

what size of pipe to use to convey any quantity of gas, any distance, with any loss of pressure and any initial or final pressure? Then use

Cox's Gas Flow Computer,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50. For sale by

A. M. Callender & Co., 42 Pine St., N. Y.

POOLE ON FUELS.

THE CALORIFIC POWER OF FUELS.

By HERMAN POOLE, F.C.S.

Second Edition. Price, $3. For Sale by

A. M. CALLENDER & CO., 42 PINE ST., N.Y. CITY.

BINDER for the JOURNAL.

Price, $1.00.

A. M. CALLENDER & CO., 42 Pine Street, N.Y.

EDMUND H. McCULLOUGH, President. CHAS. F. GODSHALL, Treasurer. H. C. ADAMS, Secretary. HENRY WHARTON, Assistant Secretary.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J.,
WATKINS (SENECA LAKE), N. Y.

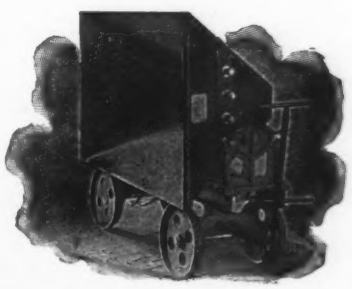
Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE LINK-BELT MACHINERY CO.,

ENGINEERS, FOUNDERS, MACHINISTS,

Chicago, U. S. A.



Tilting Coal and Coke Car.

LINK-BELT ELEVATING & CONVEYING MACHINERY for HANDLING COAL, COKE, OXIDE, ETC

Tilting Coal and Coke Cars, Breaker Rolls, Power Transmitting Machinery.

Machinery designed and erected to suit existing conditions and available space.

Special Catalogue No. 31 Sent upon Application.

PHILADELPHIA, LINK-BELT ENGINEERING CO.

THE SUN OIL CO.

Crude Oil, Gas Naphtha,
Refined Petroleum, Gas Oil.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

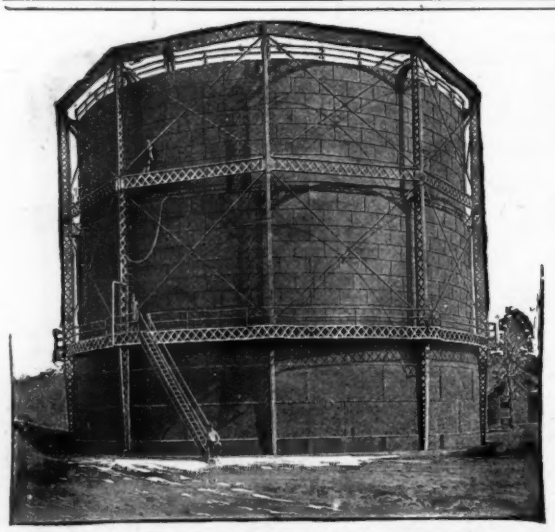
GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City.



DAVIS & FARNUM MFG. CO.,

WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors, Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

Coke Barrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe. Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

BAXTER & YOUNG,

CONTRACTING AND CONSULTING GAS ENGINEERS.

Examination and Values Ascertained of Artificial and Natural Gas Properties.

COMPLETE GAS WORKS ERECTED.

Artificial and Natural Gas Mains Furnished and Laid.

GAS PROPERTIES PURCHASED.

OFFICE: WAYNE COUNTY BANK BUILDING.

Rooms 201 & 202. DETROIT, MICH.

A. E. BOARDMAN, C. E.,

Consulting and Contracting Engineer.

Particular attention given to Gas, Water and Electric Plants. Long and successful experience with the problem and practice of

Filtration for Public Water Supply.

BREVARD, N. C.

Geo. Shepard Page's Sons.

GAS MACHINERY.

Correspondence Solicited.

180 Fulton Street, New York City.

DAVID LEAVITT HOUGH,

Consulting Engineer

AND

CONTRACTOR,

PARK ROW BUILDING, N. Y.

Practical Photometry,

By William Joseph Dibdin

Price, - - - - $3.00.

FOR SALE BY

A. M. CALLENDER & CO.,

No. 42 Pine Street, New York City.

KERR MURRAY MANUFACTURING COMPANY,

Engineers and Manufacturers

APPARATUS FOR COAL GAS PLANTS,

SINGLE AND DOUBLE-LIFT GASHOLDERS AND STEEL TANKS,

Latest Improved

ROTARY EXHAUSTERS, P. & A. TAR EXTRACTORS, AMMONIA WASHERS,

CONDENSING, SCRUBBING AND PURIFYING APPARATUS.

Street Specials and Valves.

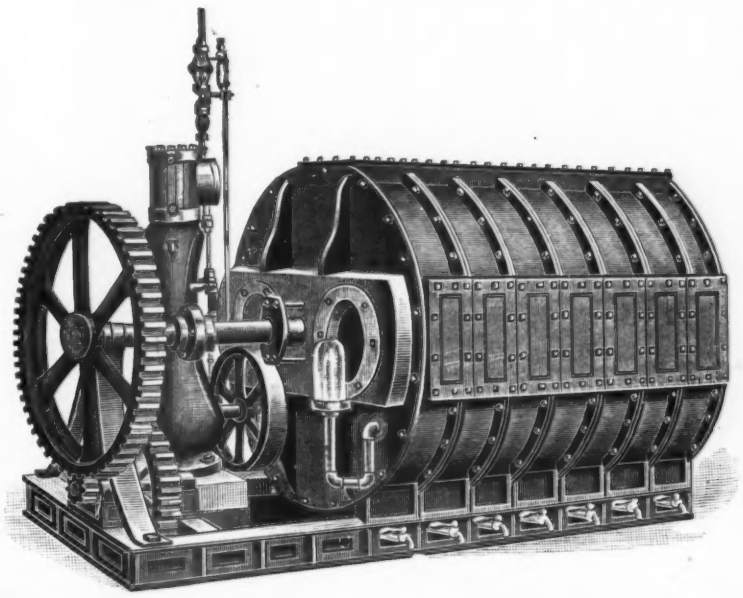
ADDRESS:

KERR MURRAY MANUFACTURING COMPANY, {FORT WAYNE, IND.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Designers and Builders of Gas Works.



Sole Lessees the Wilkinson Water Gas Process.

PATENT STANDARD WASHER-SCRUBBER.

The best apparatus for the extraction of all Ammonia and a large proportion of Carbonic Acid and Sulphureted Hydrogen. The Scrubber has been materially improved and is provided with patented Wooden Segmental Grids, instead of Metallic Discs, thus reducing the weight on shaft and power for operating same.

Coal and Water Gas Installations of the Most Modern and Complete Types.

BENCHES WITH INCLINED RETORTS.

System Stettiner Chamotte Fabrik, Actien Gesellschaft, of Stettin, Germany.

GASHOLDERS OF ALL SIZES.

General Western Agents, THE LLOYD CONSTRUCTION CO., of Detroit, Mich.

QUINTARD IRON WORKS,

N. F. PALMER,

Foot of 12th St. & East River, New York,

MANUFACTURERS OF

GAS APPARATUS.

Complete Works Erected.

FREDERICK W. FLOYD, Engineer.

ALEX. C. HUMPHREYS, M.E., M. Inst. C.E. ARTHUR G. GLASGOW, M.E., M. Inst. C.E.

HUMPHREYS & GLASGOW,

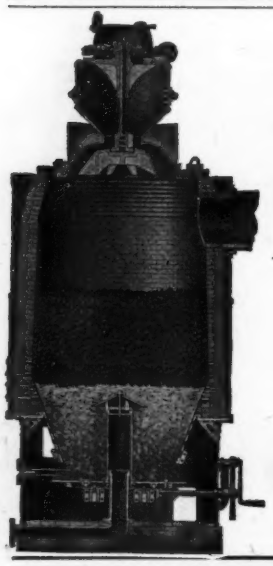
BANK OF COMMERCE BLDG., 31 Nassau Street, New York.

38 VICTORIA STREET, London S.W., England.

CONSULTING GAS AND ELECTRIC LIGHT ENGINEERS.

PROPERTIES PURCHASED.

COMPLETE EXAMINATIONS MADE.



R. D. WOOD & CO.,

400 CHESTNUT STREET, PHILADELPHIA,

—BUILDERS OF—

Gas Power Plants with Producers,

The best Producers for either Bituminous, Anthracite Coal or Lignite. Less labor required and less waste than in any other Producer. Send for Pamphlet. : : : :

CAST IRON PIPE.

HYDRAULIC TOOLS. HYDRAULIC OPERATING VALVES.

ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

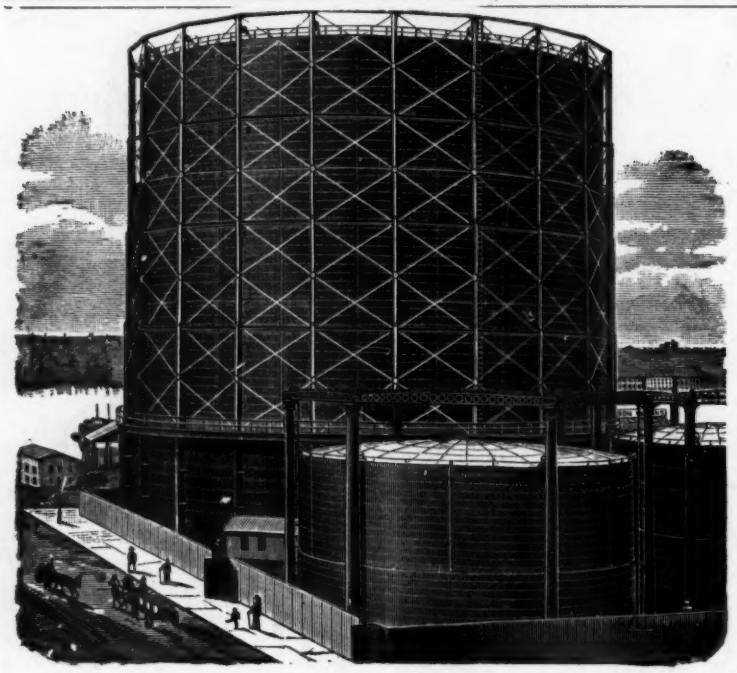
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. —OFFICES— **Bridge & Ogden Sts., Newark, N. J.**



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, Jr., Secretary & Treasurer.

West and Calyer Sts. (Near 10th & 23d St. Ferries)
NEW YORK, Borough of Brooklyn.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

STEEL GAS HOLDER TANKS.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

THE GAS ENGINEER'S LABORATORY HANDBOOK.

By JOHN HORNBY, F.I.C.

PRICE, - - - - - - - $2.50.

A. M. CALLENDER & CO., No. 42 Pine Street, New York City.

THE STACEY MANUFACTURING CO.,

MANUFACTURERS OF

Gasholders, Steel Tanks,

AND ALL IRONWORK AND MACHINERY REQUIRED IN A GAS PLANT.

ALSO THE ONLY AUTHORIZED MANUFACTURERS OF

The Chollar System of Gas Purification.

OFFICES:

No. 239 Mill Street, CINCINNATI, OHIO. 'Phone, West 690.

PLANS, SPECIFICATIONS AND ESTIMATES CHEERFULLY FURNISHED.

RITER-CONLEY MFG. CO.,

GASHOLDERS, with or without Steel Tanks.

Purifiers, Condensers, Scrubbers, Oil Tanks, Smoke Stacks

STEEL ROOFS and BUILDINGS.

PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

GENERAL OFFICE: Pittsburg, Pa. EASTERN OFFICE: 39-41 Cortlandt St., New York City.

WM. HENRY WHITE,

No. 62 Wall Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

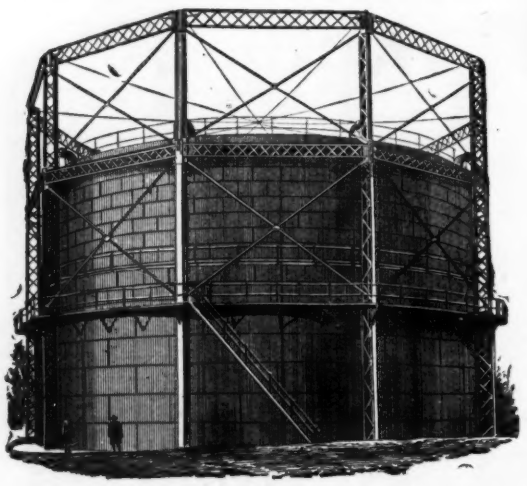
Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited.
Plans and Estimates Furnished.

1902 DIRECTORY 1902

OF AMERICAN GAS COMPANIES.

Price, - - - - - - - - $5.00.

A. M. CALLENDER & CO., - - No. 42 Pine Street, New York.



1842 ※ Deily & Fowler, ※ 1903

LAUREL IRON WORKS.

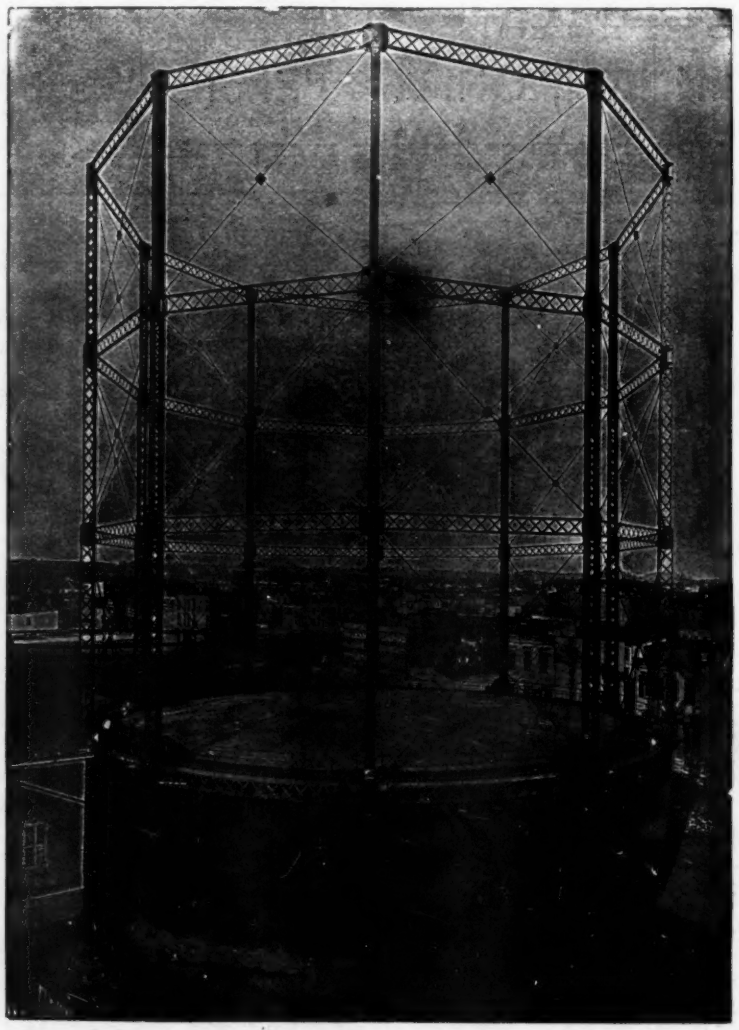
Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.



The order for this Triple-Lift Holder and Steel Tank was received by the Logan Iron Works from the Union Gas Light Company, of East New York. The contract was completed and the Holder was in actual use in 90 days from receipt of order. Capacity of Holder, 500,000 Cu.Ft.

LOGAN IRON WORKS,

Brooklyn, N. Y.

MANUFACTURERS OF

Single or Multiple-Lift

GASHOLDERS,

Complete with Steel Tanks.

BENCHES, SCRUBBERS,

CONDENSERS,

PURIFIERS, IRON ROOFS,

Self-Sealing Retort Lids,

AND ALL PARTS OF

GAS WORKS APPARATUS.

Contractors for Complete Works.

ALSO, SOLE MANUFACTURERS OF

C. W. BLODGET'S

HOT GAS SCRUBBER.

Gas Analyst's Manual,

By JAQUES ABADY, M. Inst. Mech. E.

(Incorporating F. W. Hartley's "Gas Analyst's Manual" and "Gas Measurement.")

Ninety-three Illustrations and Nine Folding Plates.

Bound in Handsome Half Leather. Price, - $6.50.

FOR SALE BY

A. M. CALLENDER & CO., - - 42 Pine Street, New York City.

Established 1854.

D. McDONALD & CO.,

MANUFACTURERS OF

WET AND DRY METERS, STATION METERS AND METER PROVERS.

ALSO MAKERS OF

THE GLOVER PREPAYMENT METER.

The amount of gas delivered for the coin can be instantly and positively changed without removing the meter or replacing any parts.

The gas registered agrees absolutely with the amount purchased by the coin.

WE HAVE MADE AND SOLD IN THE UNITED STATES

OVER 120,000 OF THESE METERS,

ALL OF WHICH ARE GIVING PERFECT SATISFACTION.

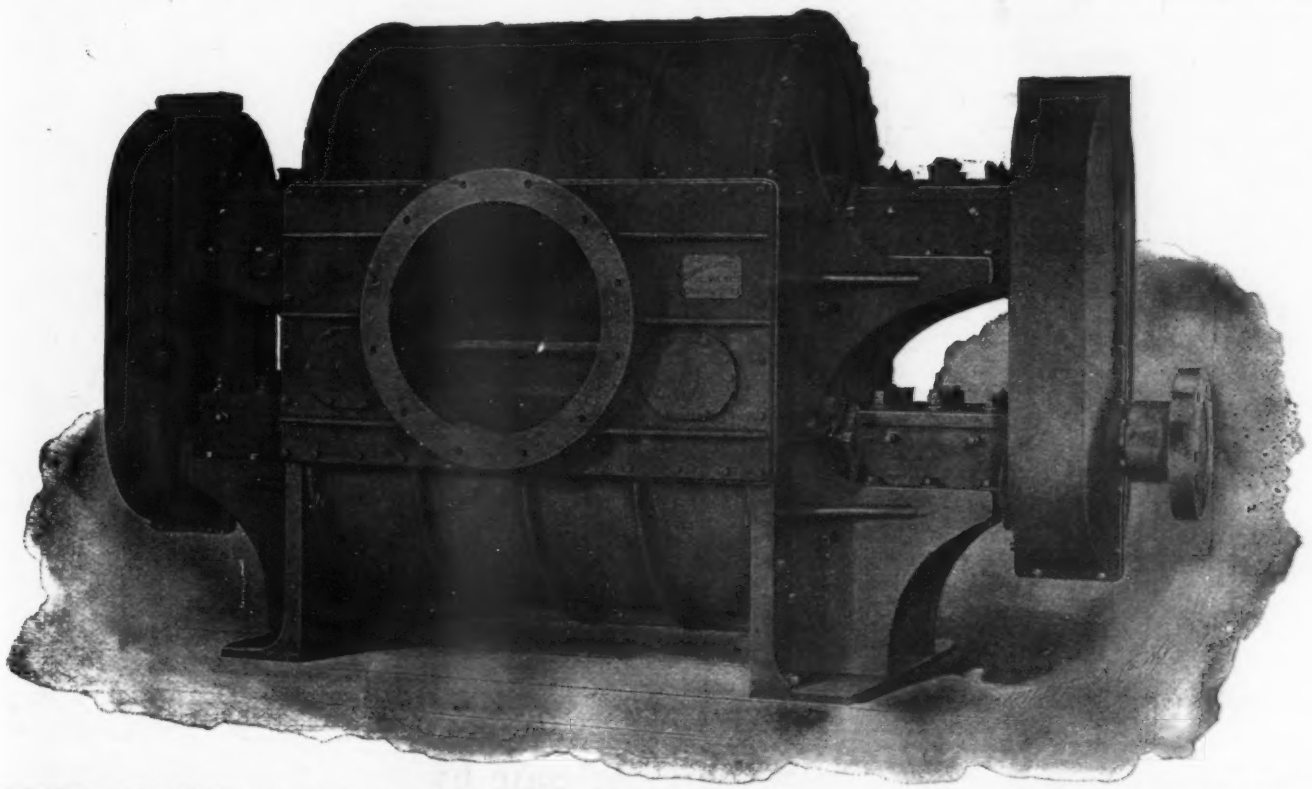
Correspondence Solicited.

561 West Forty-seventh Street, NEW YORK. | 51, 53 & 55 Lancaster Street, ALBANY, N. Y. | Jefferson and Monroe Streets, CHICAGO.

THE CONNERSVILLE BLOWER CO.,

MANUFACTURER OF

ROTARY POSITIVE PRESSURE GAS EXHAUSTERS, BLOWERS AND PUMPS.



HORIZONTAL OR VERTICAL, IN CAPACITY RANGING FROM 9,000 to 1,800,000 CU. FEET DISPLACEMENT PER HOUR.

CONNERSVILLE BLOWER CO., Connersville, Ind. EASTERN SALES OFFICE: 95-97 Liberty St., New York City.

NATHANIEL TUFTS METER CO.,

ESTABLISHED 1849.

8 MEDFORD STREET, BOSTON, MASS.

Consumers' Dry Gas Meters.
Station Meters of Any Capacity.

PREPAYMENT GAS METERS.

MARYLAND METER CO.,

BALTIMORE, North and Saratoga Streets. CHICAGO, 88 to 92 Jackson Boulevard.

CONSUMERS' AND STATION METERS, PRESSURE GAUGES, ETC.

SPECIAL ATTENTION GIVEN TO ALL REPAIR WORK.

"Have you Seen our Complaint Meter?"

ANTICIPATE YOUR WANTS

Just now, as the freight traffic is so congested it is no longer safe to count on a prompt delivery, then send us your orders for immediate attention, and we will fulfill your happiest anticipations.

KEYSTONE METER CO.,
ROYERSFORD, PA.

FIELD'S ANALYSIS
For the Year 1901.

An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the 33d Year of Publication. Compiled and Arranged by

JOHN W. FIELD,

Secretary and General Manager of The Gas Light and Coke Company, London

Price $5. For Sale by
A. M. CALLENDER & CO., - No. 42 Pine Street, N. Y. City.

AMERICAN METER COMPANY,

NEW YORK, PHILADELPHIA, CHICAGO,
SAN FRANCISCO, ST. LOUIS.

PREPAYMENT METERS.

THEIR CONSTRUCTION IS SUCH THAT THEY MAY BE READILY READJUSTED WHEN THE SCALE OF GAS RATES IS CHANGED.

HELME & McILHENNY,

Established 1848. 1339 to 1349 Cherry Street, Philadelphia, Pa.

MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED

METRIC METAL COMPANY,

MAKERS OF

GAS METERS for NATURAL and ARTIFICIAL GAS.

Special Attention given to Repairing METERS of all Makes.

FACTORY AT ERIE, PA.

EXCERPTS FROM DECISIONS

—OF THE—

BOARD OF GAS COMMISSIONERS of the COMMONWEALTH OF MASSACHUSETTS.

MR. E. H. YORKE, NEW HAVEN, CONN., Dec. 1, 1898.

Dear Sir:—I am in receipt of a copy of "Excerpts from the Decisions of the Board of Gas Commissioners," which is a handy compilation in book form of extracts from the most recent decisions of the Gas Commission of Massachusetts.

I note that most of these extracts are broad and safe-guiding precepts, which apply with equal force to one Company as to another. The 13 years' existence of the Board of Gas Commissioners with its unusual opportunities for acquiring information, have justly made it a high and safe authority in all matters pertaining to the management, obligations, and rights of Gas Companies. Your little book will serve as a valuable reference library in settling legal complications which often arise between a Gas Company and its customers.

Yours truly, (Signed) F. C. SHERMAN, Superintendent.

A 28-page Pamphlet containing the cream of this Board's decisions as to the proper management of Gas Companies.

Compiled by E. H. YORKE. Price $1.00. Address

A. M. CALLENDER & CO., - No. 42 Pine Street, New York.

JOHN J. GRIFFIN & CO.,

1513 TO 1521 RACE STREET,

559 West 47th Street, NEW YORK.

PHILADELPHIA.

Jefferson and Monroe Streets, CHICAGO.

MANUFACTURERS OF

GAS METERS,

Station Meters and Experimental Apparatus of Every Description.

PROMPT ATTENTION GIVEN TO ALL REPAIRING.

OUR SPECIAL NATURAL GAS METER

Is the Best ever offered. Over 75,000 now in use.

The Positive Prepayment Meter.

Positive Advantages:

The Income is Quick and Sure.

IT IS

Better than C.O.D.,

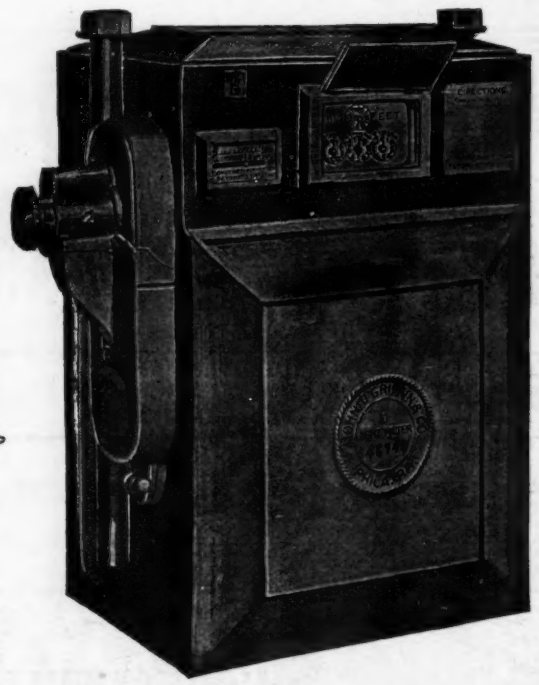
As Gas is Paid for Before Delivery. : : :

There is Money in it ☞

For the gas man.

IT WILL GET NEW CUSTOMERS.

It will KEEP the ones you have.



Negative Advantages:

No "Deposit" is Necessary to Start Business with a new customer. : : :

NO CUSTOMERS ARE LOST on that account.

No Time Lost Making Out Bills.

No Money Lost on account of Unpaid Bills. :

No Disputes on Account of Bills.

THE PREPAYMENT SYSTEM IS PROFITABLE FOR THE GAS MAN AND PLEASANT FOR THE CONSUMER.

OVER 125,000 OF THE POSITIVE PREPAYMENT METERS ARE IN USE IN THE UNITED STATES.

SEND FOR OUR BOOKLET.